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*Economic Impact of
Environmental Controls
on the Fruit & Vegetable
Canning & Freezing Industries*

PART II
INDUSTRY STRUCTURE

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A Report to
Council on Environmental Quality

P-585
November, 1971

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Agri Division
Dunlap and Associates, Inc.
Manhattan, Kansas

ECONOMIC IMPACT OF
ENVIRONMENTAL CONTROLS ON
THE FRUIT AND VEGETABLE
CANNING AND FREEZING INDUSTRIES

PART II

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PREFACE

This volume is one in a series of reports developed by the Agri Division, Dunlap and Associates, Inc. for the Council on Environmental Quality as part of a comprehensive study entitled: Economic Impact of Environmental Controls on the Fruit and Vegetable Canning and Freezing Industries. The set of reports include:

Part I: Executive Summary

Part II: Industry Structure

Part III: Impact Analysis

Part IV: Statistical Supplement

These reports complete the program of work as planned and specified under Contract PA 71-53.

→ The report concerns the economic impact of pollution control measures on the fruit & vegetable canning & freezing industries. Included is information on the following:

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EXECUTIVE SUMMARY

ECONOMIC IMPACT OF ENVIRONMENTAL CONTROLS ON THE FRUIT AND VEGETABLE CANNING AND FREEZING INDUSTRIES

I. INTRODUCTION

In an effort to reverse the progressive deterioration of the environment, currently available pollution abatement technology is being improved with intensified research and development efforts. The impact of such intensification of environmental management is being seen in terms of reduction of environmental degradation associated with the disposal of industrial wastes throughout the nation.

However, the implementation of environmental controls normally results in added costs and may result in economic and locational adjustments within these industries. It is the purpose of this study to examine these adjustments as they relate to the fruit and vegetable processing industries in terms of costs, capital requirements, profits, industry structure and location, employment, product prices and regional and national economic impacts.

The general approach used in this study was to initially analyze and describe the characteristics of supply, demand, price and operating requirements of these industries and given this base, evaluate the microeconomic relationships among representative firms within the fruit and vegetable processing industries as a first step; and, second to then project macroeconomic impacts at the industry level based on the resulting microeconomic impact relationships which were developed.

Throughout this study, excellent cooperation and assistance was obtained from Contract Representatives of the Environmental Protection Agency and from industry trade associations, particularly the National Cannery Association and the Frozen Food Institute who contributed detailed information concerning these industries.

II. DEMAND CHARACTERISTICS

The demand for canned and frozen fruits and vegetables centers on a nationwide market served mainly through retail food stores with secondary outlets being institutional food purveyors and further processors who manufacture prepared dinners and other convenience foods.

A. Products and Substitute Products

This study was restricted to a consideration of basic fruit and vegetable canning and freezing. Preserves, jams, jellies and frozen specialty products were not included. The specific products selected for study account for over 80 percent of the total volume processed.

The principal substitutes for canned and frozen fruits and vegetables are fresh fruits and vegetables. Overall, the degree of substitutability between fresh and processed fruit and vegetables is not close.

B. Size, Location and Relative Importance of Markets

Although there is some carryover of the pack of canned and frozen fruits and vegetables from one packing season to the next, total volume packed is the best indicator of aggregate demand for these products.

Total pack of canned vegetables in 1970-71 was approximately 325,596,000 cases (24/303 can equivalent). Volume packed has remained relatively stable during the past 10 years. Four products (tomato products, sweet corn, green beans and green peas) account for over 70 percent of the total pack.

Canned fruits and fruit juices pack, 1970-71, was approximately 208,113,000 actual cases. Volume has increased slightly during the past ten years, up from approximately 138,000,000 cases in 1961-62. Four fruits (peaches, apple sauce, pineapple and fruit cocktail) accounted for over 50 percent of the total pack.

The pack of frozen vegetables has risen steadily since 1961, from 2.1 billion pounds in that year to nearly 4.5 billion pounds in 1970-71. Potato products represented over half of the total tonnage frozen with peas, corn and green beans accounting for an additional 17 percent of the total pack.

Frozen fruits and fruit juices do not show the consistent upward trend which characterizes the pack of frozen vegetables. Pack of frozen fruits has been relatively stable near 700 million pounds.

Demand changes - specific products - Although there have been substantial shifts in the demand for specific canned and frozen fruits and vegetables in the last 10 years, analysis of these relationships show certain identifiable patterns.

- * There is a trend, in both canned and frozen fruits and vegetables, for increased demand for convenience products, e.g., canned and frozen potato products, etc.
- * There is a definite trend toward increased consumption of fruit juices, both canned and frozen.
- * Tomato catsup and chile sauce are gaining rapidly in demand.

Per capita consumption - Some very distinct changes have occurred in patterns of consumption of fruits and vegetables by the American consumer in the past two decades.

- * Fruits and juices - Per capita consumption of canned and frozen fruits and juices increased steadily from 43 pounds in 1950 to 67 pounds in 1970 and is expected to reach approximately 75 pounds by 1980.
- * Vegetables - Per capita consumption of canned and frozen vegetables has increased gradually over the past 20 years, from about 83 pounds in 1950 to 115 in 1970 and further increases to approximately 128 pounds per capita are projected by 1980.

International trade - Exports of canned vegetables from the United States are not of significant volume, in relation to total pack, for any item. However, the export market accounts for 9 to 15% of canned fruit cocktail, cherries, peaches and pineapple. Export markets take 41.5 percent of the U. S. hot pack orange juice volume, 18.5 percent of the canned grapefruit juice pack. Frozen concentrated orange juice is the principal frozen product exported. Exports of frozen vegetables are of little importance.

Canada and Western Europe are the principal export markets.

Imports of processed fruits, vegetables and juices are primarily tropical or subtropical products not produced in the United States. However, imports of canned apple juice and pear juice, canned pineapples and juices, frozen strawberries and blueberries, tomato products and mushrooms are imported in substantial quantities and do compete with similar products processed in the United States.

Government purchases are an important element of total demand for canned products and account for 4 to 6 percent of the total pack of canned fruits and vegetables and 10 to 12 percent of the total canned juice pack. Governmental use accounts for 2-3 percent of the total pack of frozen fruits and vegetables and slightly over one percent of the frozen juice pack.

C. Recent Trends in Demand and Price

Demand trends - A more detailed examination of total industry demand shows that the demand for certain specific products is advancing while for others demand is declining. With the exception of tomato juice, apples, lima beans and strawberries, the demand trend for processed fruits and vegetables has been either constant or increasing over the past ten years.

Price trends - Prices of canned and frozen fruit and vegetable products vary from year to year in response to current year pack and year-end carryover stocks. In addition, they are subject to exogenous economic pressures related to production and processing costs and purchasing power of consumers. During the past five years prices have generally trended upward with the exception of corn, lima beans, tomato juice and cherries.

D. Distribution Systems

Eighty-four percent of the canned fruits and vegetables move into use through retail food stores. Retail chains handle 49 percent directly and wholesale or cooperative buying groups 35 percent. Sixteen percent move through institutions, government, and to further processing.

Frozen products follow a similar pattern except a lesser percentage moves directly to the consumer while 28 percent goes to further processing and 15 percent to government and institutions.

E. Market Competition

Although the fruit and vegetable canning and freezing industries are characterized by the existence of large, multi-plant, multi-product firms, the industry is, nevertheless, highly competitive. There are a large number of small canners and freezers and the industry is faced with the necessity of selling a high proportion of its total pack to large, national food chains. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions.

F. Governmental Influences

The principal governmental influences relating to the fruit and vegetable industries are concerned with product and container standards, plant and product inspection and labeling requirements. There is little direct governmental influence over the marketing of these products.

III. SUPPLY CHARACTERISTICS OF THE FRUIT AND VEGETABLE INDUSTRY

The fruit and vegetable canning and freezing industries are supply-oriented in that, because of the perishable nature of the raw products, location of processing plants is largely dictated by the location of raw product production.

The diversity of products processed and seasonality of production of basic fruit and vegetable crops results in a nation-wide network of canning and freezing plants. However, major areas of processing are found as certain areas offer the greatest potentials for fruit and vegetable production.

A. Types and Locations of Raw Materials

Vegetables for Processing - Production of vegetables for processing is widely dispersed throughout the United States and commercial production is found in every state. However, production is concentrated (51% of total) in the West, mainly in California and the Pacific Northwest, with the North Central Region (31%) being the other major producing area.

Fruit Production - Nearly every state is a commercial producer of some kind of fruit, but production is concentrated in relatively few states. Seven states (California, Florida, Washington, New York, Michigan, Oregon and Pennsylvania) accounted for 88 percent of the total U. S. fruit tonnage, 1967-1969.

B. Number and Location of Firms/Plants

Fruit and Vegetable Canning Plants - The number of canning plants in the United States decreased from 1630 in 1958 to 1223 in 1967, a decline of 25 percent. There has been some slight shift in relative regional importance with the West and South gaining slightly over the East and Midwest. The leading states are California, 170; New York, 106; Wisconsin, 91; Florida, 69; and Maryland, 65. Based on historical trend, 800 plants are projected for 1980.

Fruit and Vegetable Freezing Plants - In contrast to fruit and vegetable canneries, the number of freezing plants increased from 303 in 1958 to 650 in 1963 but decreased to 607 in 1967 -- down 6.5 percent and is projected to decrease to 505 by 1980. The greatest number is in the West (32.6%) and the remainder are evenly distributed throughout the United States. California has the most plants (85), followed by New York (47), Washington (46), Illinois (36), Michigan (34) and Oregon and Pennsylvania.

C. Characteristics of Fruit and Vegetable Canning and Freezing Plants

Size of firms - A detailed analysis was made of the volume packed of a selected sample of 598 canners and 231 fruit and vegetable freezing firms.

Canners - Over a third of the firms analyzed (35.7%) would be considered as small canners, with an annual pack of less than 250,000 cases. At the other end of the range, 28.6 percent packed over 1,000,000 cases and 19 percent packed over 5,000,000 cases each.

Freezers - Approximately 30 percent of all freezers analyzed would be classed as small, with annual volumes of less than 5 million pounds. However, 46.6 percent would be considered large (annual volume in excess of 20 million pounds) and 22.9 percent had annual packs of over 100 million pounds.

Concentration of Processing Operations - The canning industry is characterized by a large number of firms, but a few major canners pack a high percentage of the total volume. Consequently a large number of small canners share a small segment of the total market. For the major canned commodities the largest third process approximately 80% of the product; the middle third processes approximately 15% of the product; and the smallest third processes approximately 5% of the product.

Although similar data were not available for freezing, it is believed that similar concentration exists in that industry.

Single Plant vs. Multiplant Firms - Over 85 percent of the canners in the United States are single plant firms. Of the remainder (14.9%), the two largest firms operated 31 plants each, one firm had 24 plants, two had 17 plants and one had 16 plants.

Eighty-two percent of the freezers were single plant firms. The largest firm had 9 plants, the second largest 8, third 7 and the other two large firms had 6 plants each.

Single Product vs. Multiple Product Plants - Most canners were multiple product plants, 64.4 percent packing more than one product.

The same situation existed for freezers, where 57.5 percent were multiple product operations and 20 percent packed 4 or more products.

Diversified vs. Specialized Plants - Primary products (basic fruits, vegetables and juices) represented 90 percent of the total value of gross sales of fruit and vegetable freezing plants.

Stage in Production Process - All plants considered in this analysis were primary canners or freezers of fruits and vegetables. No secondary (reprocessing) activities were considered.

Degree of Integration - There is only a small degree of vertical integration (either forward or backward) in the fruit and vegetable processing industries. Only about 8 percent of canned fruits and vegetables and 9 percent of the frozen products were produced on land owned or rented by processors.

D. Employment

Fruit and vegetable canners and freezers are major employers of labor in the areas in which they operate. Further, they employ a high proportion of low-skilled workers in relation to total employment in the industry.

Employment by canners dropped from 108,400 in 1958 to 100,000 in 1967, a decline of 7.7 percent. At the same time, employment per plant increased from 66 to 82.

Employment by freezers in the 1958-67 period increased from 39,500 to 64,500, a gain of 63 percent. Average number of employers per plant increased from 93 in 1958 to 106 in 1967.

E. Capacity and Utilization of Capacity

It is recognized that appreciable excess capacity normally exists in both the canning and freezing industry. Utilization of capacity is generally higher in larger plants and in intensive, commercial production areas. Due to the fact that there is substantial year-to-year variation in the production of fruits and vegetables, 10-20 percent standby capacity is desirable. However, the only definitive study made showed utilization rates in Southern plants at 57 percent by canners and 74 percent for freezers.

F. Industry Segmentation

For the purposes of this study the canning and freezing industries were segmented by size. A "large" plant represents the average size in the largest third of the industry and approximately 80 percent of total volume; the "medium" size plant, the middle third and 15 percent of total volume; and the "small" plant, the smallest third and 5 percent of the volume.

IV. METHODOLOGY

The economic impact of pollution abatement costs on the fruit and vegetable canning and freezing industry can affect different sized plants in different ways. Economies of scale in processing costs as well as pollution abatement cost will lead to a differential impact on individual firms. A microeconomic evaluation of plants within the fruit and vegetable processing industry was conducted to assess probable impacts within the industry. From this base of information, overall impacts on the industry were projected.

A. Analytical Approach

For this study an economic-engineering approach was used to provide costs and revenue situations for representative processing plants. A 20-year planning horizon was used to simulate operations, both with and without internalized pollution abatement controls.

A series of operating situations for representative plants were simulated based on volume of operation, level of technology, level of capacity utilization, number of products and length of operating season. All these assumed operating conditions will affect the profitability of a processing plant and its ability to withstand pollution abatement costs.

The economic performance of individual plant operations was evaluated using the technique of discounted economic cash flows and internal rate of return analysis. This analytical technique is widely used in investment feasibility analyses and is appropriate for purposes of this study to assess economic impacts of proposed additional investments in pollution abatement facilities.

The internal rate of return, as a measure of investment feasibility, provides a "present value" comparison of current and future costs and income streams resulting from a plant operation. In essence, the internal rate of return is the discount rate which makes the "present value" of money invested in a given project over a period to time equal to the "present value" of money received over the length of the project.

This analytical technique by-passes the many problems of depreciation assumptions, etc. that would be necessary in an analysis of present unit cost of processing operations both with and without pollution abatement controls.

B. Water Pollution Abatement Costs

Water pollution abatement costs used in this study were provided by the CEQ. They were calculated with a computer based model developed to estimate both investment capital and operating capital required by the nation's industries

to attain water pollution control standards. These "standards" are defined as equivalent of secondary treatment.

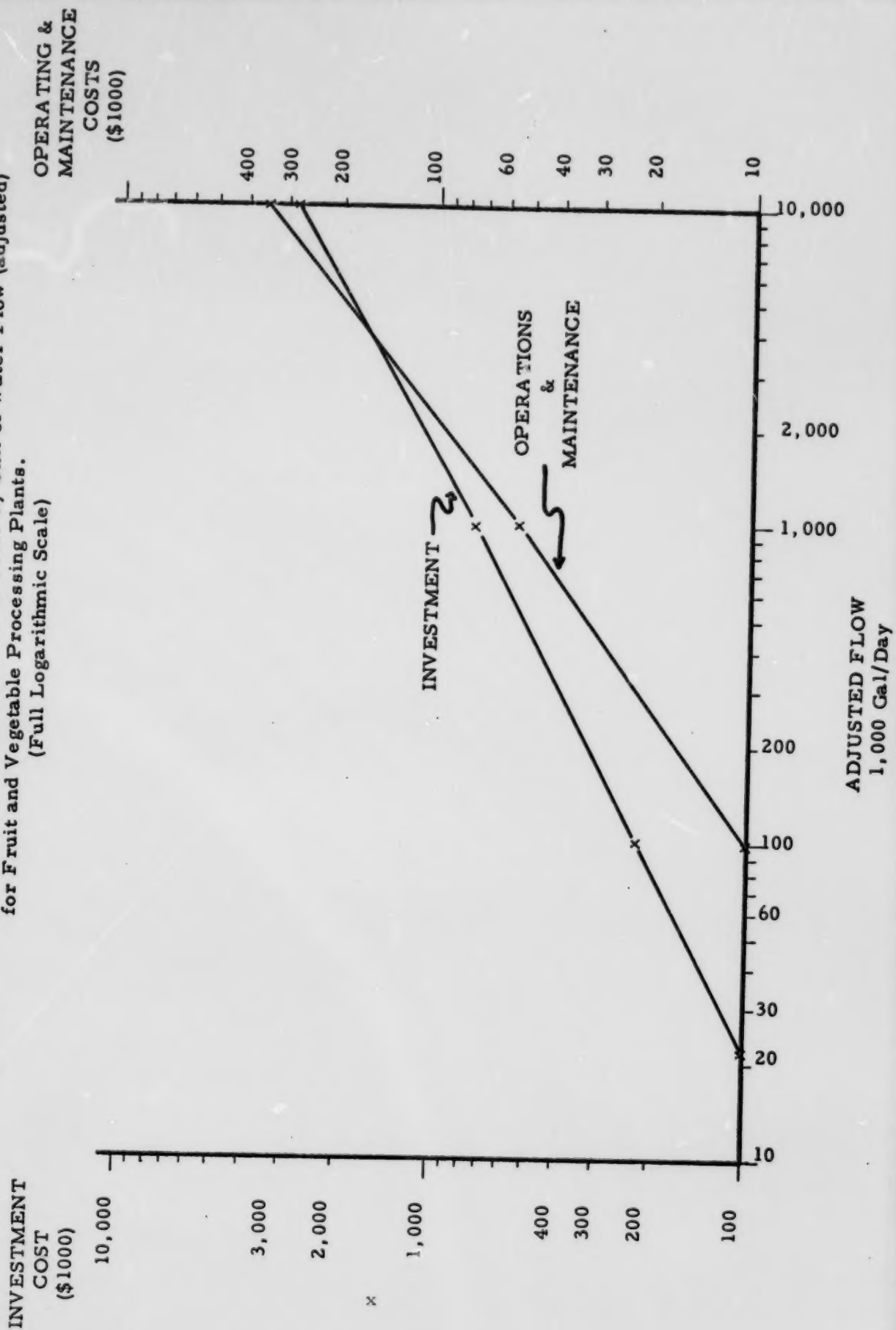
The configuration for a water plant to serve a fruit and vegetable processing plant is based on the following technology:

<u>Method</u>	<u>Percent of Wasteflow Processed</u>
Equalization	50
Flotation	100
Sedimentation	100
Biological stabilization	140

The actual flow of waste water was calculated by the kind of product processed and the number of cases processed per day. The actual flow of waste water was "adjusted" by a scaling factor of 2 to the .6 power to account for level of pollutants in waste water from the fruit and vegetable industry.

The adjusted flow was used to derive the appropriate capital investment and operation and maintenance cost from the relationship shown in Exhibit 1. The Council on Environmental Quality recognizes these costs are subject to variation under alternative conditions and established a reasonable range of -30 percent to + 30 percent.

Exhibit 1. Estimated Pollution Abatement Costs by Unit of Water Flow (adjusted)
for Fruit and Vegetable Processing Plants.
(Full Logarithmic Scale)



V. INDUSTRY ANALYSIS

Economic cash flows were developed for major product lines under alternative conditions. Wherever data would allow, cash flows were developed for representative plants with an annual volume equal to the industry average for the largest third, middle third and smallest third plant groupings. Average volumes for the representative plants amounted to 80 to 200 cases per hour for the small plants, 170 to 400 cases per hour for the middle sized plants and 600 to 1,500 cases per hour for the large plants.

A. Size of Firms

Volume of production by type of plant proved to be a major factor in the level of returns. Large plants consistently proved to have higher returns than medium, or small size plants. For example, the internal rate of return for the multiproduct pea and corn canning plant was calculated at 50 percent for the large, 18 percent for the medium and 7 percent for the small. Data used for different product lines came from different sources, thus the rates of return should not be used to compare one product line with the second. The relative impact of size on various product lines was, however, comparable.

B. Impact of Other Variables

Capacity - The fruit and vegetable processing industry is currently operating at a level less than capacity. In the South the utilization rate was estimated at 57 percent for the canning industry and 74 percent for the freezing industry. Nation-wide the capacity is recognized at less than 75 percent. The rate of return drops sharply as the level of operating capacity is reduced -- on the average from 25 to 50 percent when operating capacity was reduced from 100 percent to 75.

Length of operating season - Because raw product availability is limited to specific short seasons, a single line plant may operate for as little as two months while other multiproduct firms may operate for as long as nine months. The effect of a longer season may be gained by operating at two or even three shifts. The longer season a plant can operate, the analysis shows, the more efficient it becomes.

Level of technology is difficult to assess in the fruit and vegetable industry. Many of the plants are relatively old, but throughout their useful life new equipment is added or used to replace that which is old or technologically obsolete. Many plants have been located at the same site for 20 to 40 years. As a result, most plants in the industry are a combination of old and new equipment. Generally, the newer equipment installed represents a higher level of technology than the old.

Even though capital investment costs are considerably lower in the older plants, higher operating cost generally offsets the advantage and results in a lower rate of return than newer plants. For a large plant with no pollution abatement facilities, returns are reduced from 42 percent to 33 percent for prevalent technology and 29 percent for old technology. A similar pattern exists for medium size plants, but older small plants perform at about the same level as the new plants. In other words, the older small plants are able to compete reasonably well with the newer ones.

C. Sensitivity Analysis of Pollution Abatement Cost

The impacts of pollution abatement costs at the micro level were evaluated, in part, by increasing revenues for the firm with abatement costs, to the level where the firm was operating with the same internal rate of return as experienced before pollution control. In effect this demonstrates the percent increase in revenues (or prices) required to cover the pollution abatement costs for a given firm.

The impact of pollution abatement costs were analyzed for each product grouping and a sensitivity analysis conducted for each. The analysis conducted on the corn and pea canning plants is shown on Exhibit 2 for illustrative purposes. Various increases in revenue were developed, then the rates of return were interpolated to identify the new price level which would provide sufficient revenue to offset the abatement cost. For the large corn and peas plant a 6.3 percent increase in product revenue is required, 8.6 for the medium plant and 11.0 percent for the small.

For the sensitivity analysis the pollution abatement costs were altered by 130 for the upper bound and 70 for the lower bound. This was for both investment cost and operation and maintenance cost. The revenue increase for the large plant under these conditions ranges from 4.4 to 8.1 percent. For the medium size plant the range is 6.1 to 10.3 percent and for the small the range is 7.7 to 12.6.

For those plants that must provide their own facilities, the following may be considered representative:

Plant Grouping	Percent of Total Volume	Percent Required Price Increase		
		Low	Average	High
Large	80	3.9	5.5	7.5
Medium	15	4.6	6.4	8.1
Small	5	7.2	9.6	11.6
Weighted average increase required		4.8	5.8	7.8

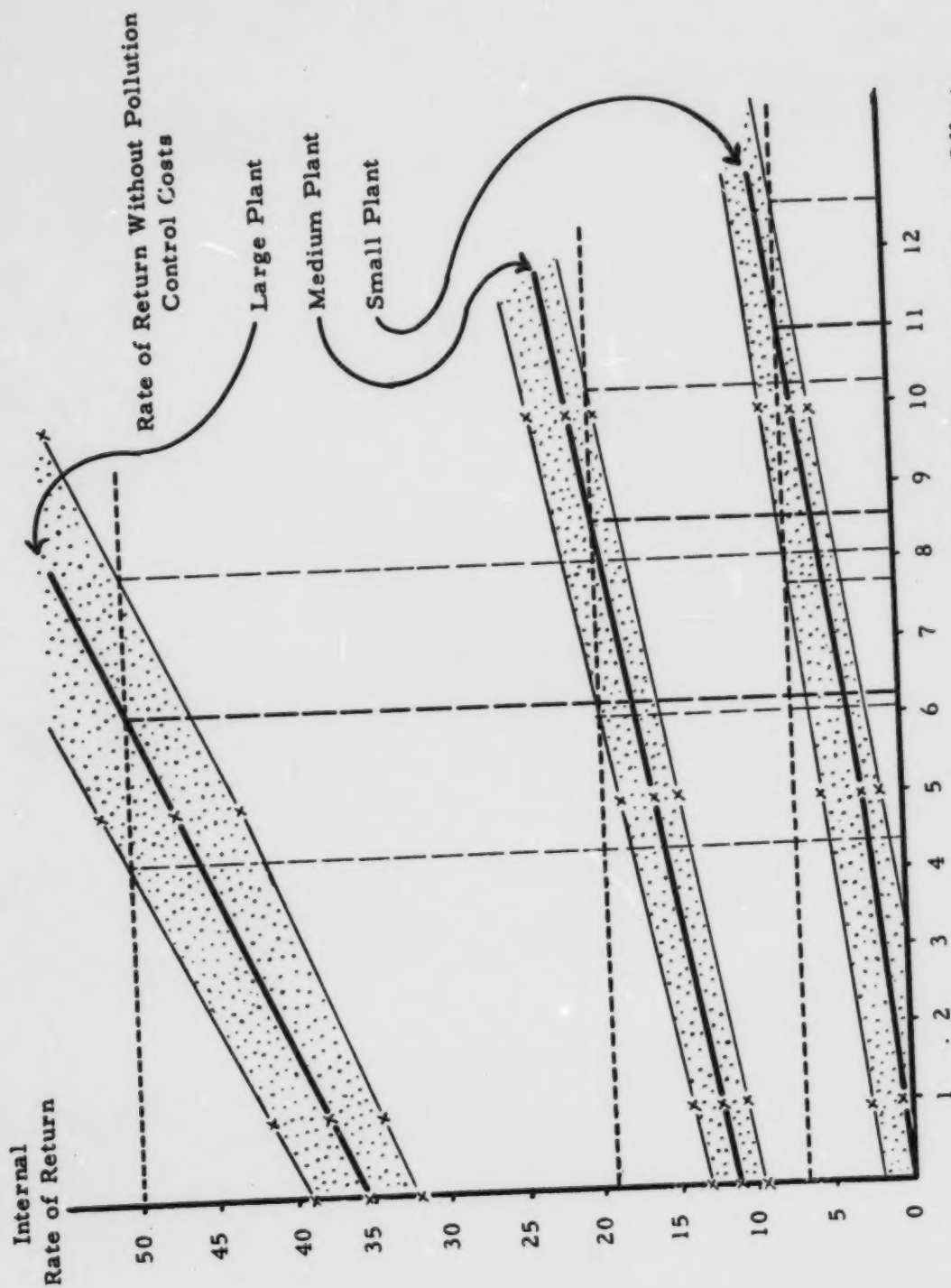


Exhibit 2. Price Increases Required by Various Sized Pea and Corn Canning Plants to Offset the Estimated Cost of Pollution Abatement Facilities (Plus or minus 30 percent)

Assuming that 50 percent of the individual plants will use municipal facilities and that they will not be subsidized by local communities, but must pay the incremental cost for use of a small city system, this will amount to the following:

Plant Grouping	Percent of Total Volume	Required Price Increase		
		Low	Average	High
Large	80	1.6	2.5	3.1
Medium	15	2.4	3.1	3.9
Small	5	2.5	3.2	4.2
Weighted average increase required		1.8	2.6	3.3
Average plant and municipal treatment		3.3	4.2	5.5

According to information received from CEQ, about 58 percent of the abatement technology is installed and is currently being paid for under present operating conditions and present price levels. Thus the overall price increase necessary to recover costs in pollution abatement facilities would amount to 1.8 percent with a range from 1.4 to 2.3 percent.

VI. OVERALL IMPACT ON THE INDUSTRY

Because of the unique structure and competitiveness of the fruit and vegetable processing industry, pollution abatement facilities will have very serious consequences on the industry itself. Unless some lower cost pollution abatement alternative such as municipal treatment can be found the smaller third -- and to some extent the middle third -- of the plants will be seriously impacted. They most likely will not be able to recover the cost of installing and operating the abatement facilities and will most likely be forced to shut down. Little impact, however, will be felt by the ultimate consumer of the fruit and vegetable products.

A. Price Increase

With an overall expected price increase of 1.4 to 2.3 percent, the less efficient medium sized plants and especially the small plants can not be expected to recover the costs expended for pollution abatement facilities unless they can develop lower cost alternatives. In addition, many of the small and medium size plants are currently operating in a marginal position and would not be able to cover the abatement costs from their current profit level. Larger plants appear to be in a stronger position. If the small and medium size firms would attempt to raise prices to the level where they could recover the costs of their pollution abatement facilities, they would be quickly undersold by the larger firm.

It should be remembered that the estimated level of capacity at which the industry is operating is approximately 75 percent or less. At that rate the large firms could quickly step up production to fill the void of the small and medium size plants that may be forced out of business.

Little impact of pollution abatement will be felt by the ultimate consumer. Because of the relative inelastic demand for fruits and vegetables, the resultant decrease in per capita consumption of fruits and vegetables is estimated at 0.5 to 1.0 percent or approximately 1 to 2 pounds per capita. This would be less than the total annual increase in consumption resulting from population expansion and projected increases in per capita consumption.

B. Impact on Profitability and Financial Position of the Industry

Profitability in the fruit and vegetable industry is generally considered low. With pollution abatement standards imposed on the industry profit margins will be further reduced because of the structure and competitive nature of the industry. While average incremental costs for pollution abatement are expected to be passed through to consumers, the smaller firms are expected to have much higher than average per unit costs of abatement.

Capital requirements for the fruit and vegetable industry are obtained primarily from standard commercial sources outside the industry. A firm must compete in the capital markets along with all other firms seeking capital. The primary requirement then is a demonstrated record of good performance and the individual firm's ability to project adequate net returns following an expanded investment program. Consequently, capital availability is directly related to profitability -- and the smaller, inefficient firms have difficulty raising the needed capital to stay in business.

It is anticipated that additional capital requirements for financing pollution abatement measures will also principally be sought from standard commercial sources. When smaller firms are not able to present evidence that they can increase prices to offset the abatement costs -- and when abatement financing requirements amount to 50 to 100 percent of their total capital investment -- small firms will simply not be able to compete in commercial financial markets for capital necessary to install pollution abatement facilities. The larger-more efficient plants, in a good position to recover a portion of their costs, will be in a much stronger position.

C. Industry Dislocations

The fruit and vegetable processing industry is comprised of many firms differing in process (canning, freezing), products processed (multi-single), size (rate per hour), length of season (long, short), capacity and utilization of capacity, level of technology (new/old) and other factors.

It is therefore extremely difficult to make broad generalizations for the industry. It would appear, however, from our analysis that the major variable is size of operation. From our analysis then, we can conclude that the small firm producing 5 percent of the total product and the medium size firm producing 15

percent of the product are faced with very serious difficulties should they be forced to add pollution abatement facilities to their operations. Other studies and our informal survey of key states indicates that roughly half of the plants will be able to utilize municipal facilities or possibly other low cost operations. This means that roughly one-third of the plants in the industry will be forced to shut down unless other low cost pollution abatement facilities can be developed. With approximately 1,200 plants in the canning and freezing industry this could mean the shut down of 400 plants.

Location - Many of the marginal processing plants likely to be affected adversely by pollution abatement controls are located in areas or regions of the country that are already relatively economically depressed. Processor, grower and associated businesses are generally a major component of local economic development in these areas; and, consequently, any appreciable impact on these businesses will also impact the entire local economy via indirect multiplier effects on area incomes, employment, sales, level of trade, etc. Such effects are likely to be far more consequential in aggregate than the direct impacts of pollution abatement on the industry itself. Specific locational effects are discussed in Part III.

D. Employment

Since many fruit and vegetable processing plants are located in relatively small urban centers and rural areas, the potential impact of dislocations may be born disproportionately by areas which already lag the nation in economic health. Approximately 90 percent of the employees of processing plants are relatively unskilled and only part-time employed. This large segment of the total labor force required is not generally mobil and would have difficulty relocating. The remaining 10 percent of management and higher-skilled production worker labor force would be more mobil, but many would not likely be needed or absorbed for some time by the remaining industry given current widespread underutilization of capacity in the industry.

The potential for individuals to shift from small plants that might be dislocated to larger plants is of limited significance. For example, the sweet potato canning plants analysed in this report had a production worker labor force of 55 people for the small (80 cases per hour), 90 for the medium (280 cases per hour), and 190 for the large (760 cases per hour). If 400 small and medium size plants were forced to shut down this would directly result in the loss of jobs by 28,000 employees.

E. Raw Product Suppliers

The impact of economic dislocations in the canning and freezing industries will be felt quite strongly by raw product producers. The industry, as pointed out earlier, is supply oriented. The locational pattern of processing plants is directly linked to the raw product production pattern. A majority of the

processing firms procure their raw product supplies from an area within 50 miles of the plant. Again, the opportunity to produce for larger processors is given little significance.

F. Supplies and Customer Impacts

Supplier Impacts - Suppliers of inputs will be affected mostly on an area-by-area basis due to expected plant dislocations rather than in aggregate. This follows in that industry-wide supply requirements, while perhaps depressed in the short-run, will soon return to and exceed previous levels. On the other hand, area-by-area dislocations will probably be long term.

Customer Impacts - Wholesale and retail customers can expect higher prices for products with consequent higher retail prices to final consumers. Given probable "pass-through" of prices, the net affect on the customer industries is expected to be relatively minor. An overall expected price increase of 1.4 to 2.3 percent and the generally inelastic nature of demands for fruits and vegetables, plus normal growth in demand, suggest that total volume of demand will not decrease drastically given the expected increase in price. A possible decrease of 1 to 2 pounds per capita can be expected.

G. International Trade

Imports of Processed Fruits and Vegetables - The impact of increased imports of processed fruits and vegetables associated with anticipated increased costs of domestic processed products, is generally expected to be limited.

Exports are significant for selected products and higher processing costs will affect the U. S. competitive position in foreign markets. If sales are reduced, a deterioration of U. S. balance of payments will result. The extent of this deterioration will depend on how effectively the particular segment of the industry can control pollution at a minimum cost.

Balance of Payments - The overall tendency of pollution abatement controls in the fruit and vegetable processing industry, because of relatively higher domestic prices, will be toward an adverse balance of payments: export sales volume will tend to be less, while import purchases will tend to be higher. However, loss in sales volume will be partially off-set in terms of balance of payments via higher prices. The net impact will not likely be substantial, however.

VII. SPECIFIC ECONOMIC DISLOCATIONS

A. Regional Impacts

A major effort was placed on determining expected differential region/area impacts of pollution abatement costs on the canning and freezing industries. The method used was to identify all known plants by location and other key attributes, particularly size. Cross-tabulation analyses were then completed with emphasis on size distribution patterns of all processing plants among regions, states, and counties within the continental United States.

A total of 1188 canners, freezers and combination canner/freezers were included in the analysis. A summary of results are illustrated in Exhibit 3, which is presented in four parts as follows:

Part A: Number, Type and Size Distributions of All Canning and Freezing Plants by Census Region, 1970.

Basic numbers of various type plants are presented by census region. For the U.S. as a whole, about 70 percent of all plants are canners, and approximately 15 percent are freezers and, also, combination canner/freezers.

A key distribution, however, is the size distribution of all plants among regions. Each type of plant was coded into three groupings: 'small,' 'medium,' and 'large,' so that approximately one-third would be in each for the U.S. as a whole. Hence, of primary interest is to identify those regions/areas which deviate from the overall average. Furthermore, on the premise that small plants will be most adversely impacted, concern is focused on region/areas containing above average levels of 'small' plants.

Part B: Percentages of Small Plants in Total and in EDA Qualified Counties Only

This bar graph of regional percentages of 'small' plants relative to total plants illustrates a wide variability in percentage levels among regions. Also, four of the nine census regions are shown to be above the U.S. average percentage: (1) New England, (2) South Atlantic, (3) Middle Atlantic, and (4) Mountain. These regions are expected to be more severely impacted relative to the remainder due to the higher concentrations of small plants. (See Part C for location of regions.)

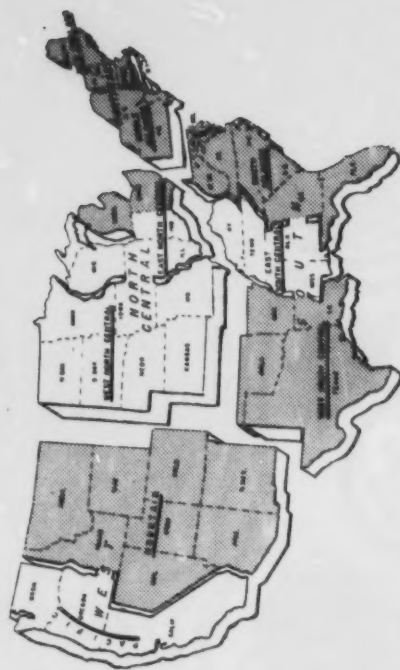
PART A

Number, Type and Size Distributions of All Canning and Freezing Plants, by Census Region, 1970

Census Region	Total No.	Per.	All Plants			Percent by Size		
			Canner	Freezer	Both	Small	Medium	Large
New England	12	3	19	9	4	53	34	9
Middle Atlantic	179	15	121	24	30	42	30	27
E. North Central	270	23	221	17	40	35	28	37
W. North Central	45	4	41	2	2	24	24	51
S. Atlantic	205	17	152	25	28	52	30	18
E. South Central	25	2	16	6	1	20	32	48
W. South Central	81	7	70	6	7	12	31	37
Mountain	49	4	33	8	8	19	27	33
Pacific	294	25	166	77	51	26	30	44
Total U.S.	1188	100	841	176	171	16	29	34

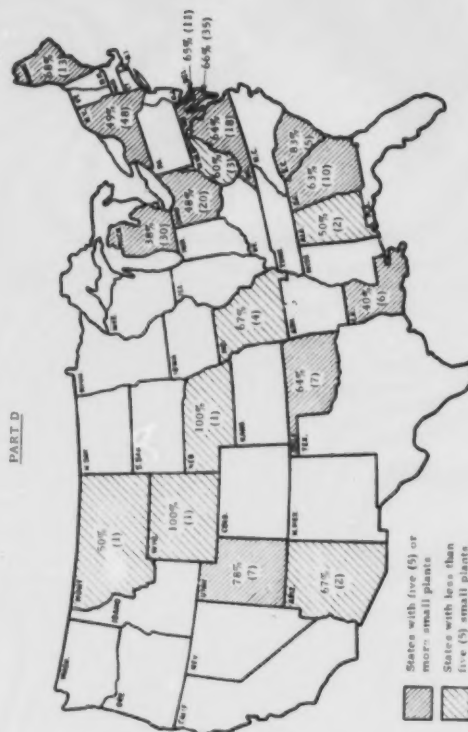
Source: Agri Division, Dunlap and Associates, Inc.

PART C



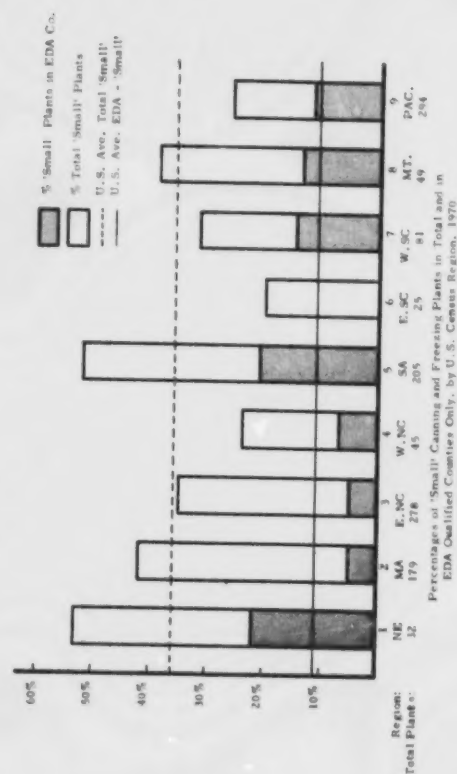
Major Regions with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants, (Plus Other States with More than 5% Small Plants and Above Average Percentage of Small Plants), 1970

PART D



States with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants, 1970

PART B



A secondary measurement depicted in this graph in the percentage of 'small' plants which are also located in Economic Development Administration (EDA) qualified counties. Overall community impacts are expected to be especially critical should plants in these areas be shut down.

Part C. Major Regions with Above U.S. Average Percentage of 'Small' Plants

The four census regions with higher than average concentrations of small plants, as described in Part B, are shaded on the U.S. map shown. In general, the East, South and Rocky Mountain areas of the country are expected to be most seriously affected with the adoption of pollution controls.

Part D. States with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants

Cross-tabulation analyses were also completed on location bases smaller than census regions, e.g., states, economic regions and subregions and counties. This part of the exhibit shows states having percentages of small plants above average.

On this less-aggregate basis, a more precise identification of probable 'problem areas' is obtained.

B. Local Impacts

The above overview of small plant distributions by region and state represents relative differences among these areas. However, all regions do have 'small' plants -- ranging from 20 to 53% as shown in Part A above. Thus, no region will be completely unaffected. (Also marginal 'medium' plants are expected to be impacted adversely. Note that 'medium' plants are rather uniformly distributed by region, however.)

A separate analysis on a county-by-county basis was also made to ascertain probable absolute impacts on local areas. A summary of all counties within the U.S. which have two or more small plants (regardless of the relative criteria above) is as shown in Exhibit 4.

While many counties with only single 'small' plants are not shown (about 60 percent of all small plants are in the counties depicted), those shown are representative of local areas which will be impacted. Special note

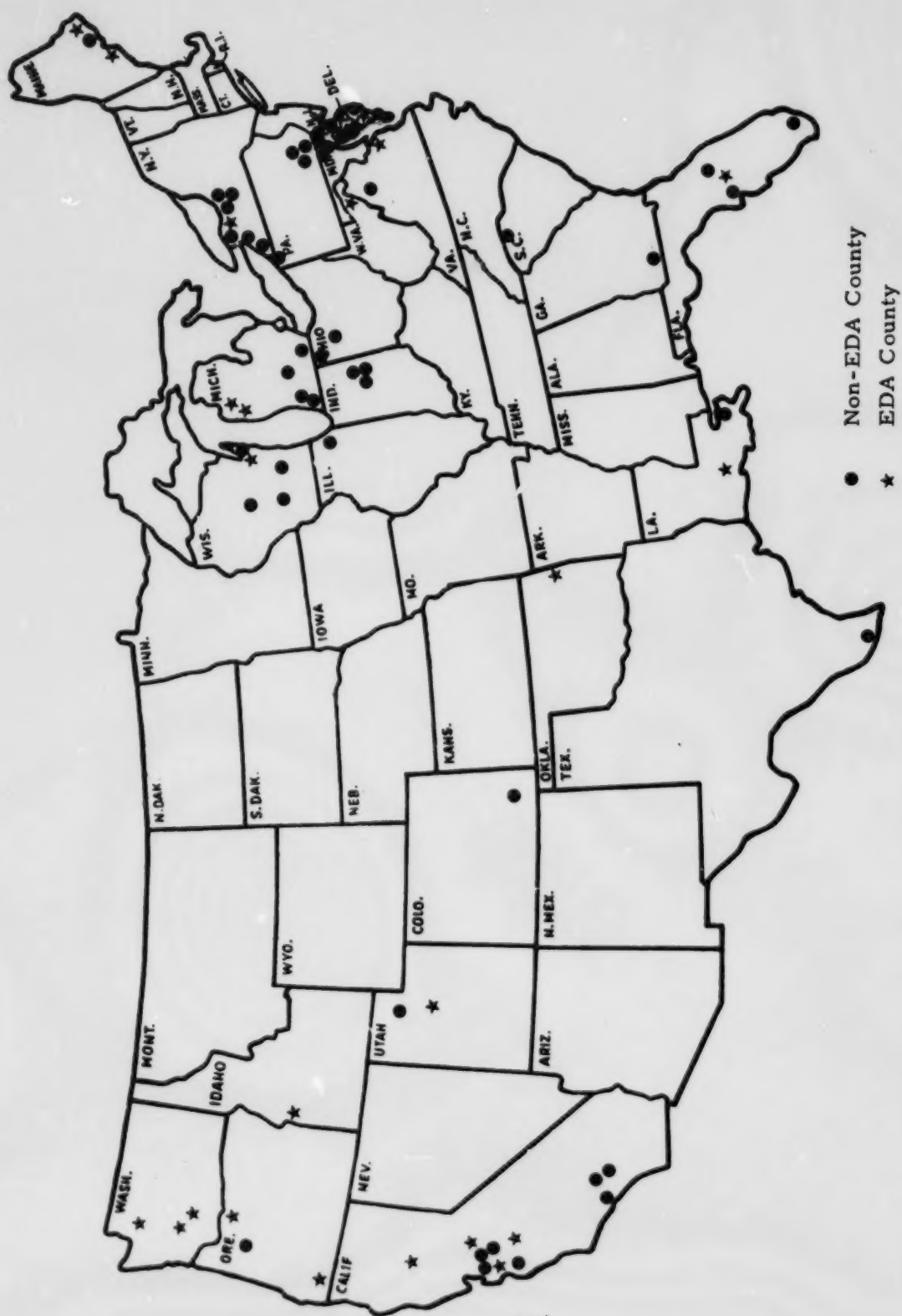


Exhibit I-4. Counties with Two or More 'Small' Canning or Freezing Plants (Approximate Actual County Locations), 1970.

is made of those areas, particularly in the West and North Central states, which will be impacted even though the affected plants are relatively few in comparison to total plants in their respective areas. Note again the distinction of EDA vs. Non-EDA counties. More adverse associated economic dislocations are projected for 'small' plants in EDA counties which are likely to be shutdown.

Further local area analyses are presented in Part III of this report. Also, individual plant data by county are provided in the Part IV Statistical Supplement.

ECONOMIC IMPACT OF ENVIRONMENTAL CONTROLS ON THE FRUIT AND VEGETABLE PROCESSING INDUSTRIES

I. INTRODUCTION

In an effort to reverse the progressive deterioration of the environment, new environmental standards are being established at federal, state and local levels. Currently available pollution abatement technology is being improved with intensified research and development efforts resulting in new and more advanced environmental control equipment, processes and systems. The impact of such intensification of environmental management is being seen in terms of reduction of environmental degradation associated with the disposal of industrial wastes throughout the nation.

However, implementation of environmental controls normally results in added costs to affected industries and may result in economic adjustments within these industries. The nature and extent of such adjustments must be considered in developing an effective and equitable program of environmental controls. The evaluation of the economic impact will require an answer to a series of important questions:

- What is likely to happen in terms of profitability, growth and capital availability in the industry?
- What are the price effects on its products?
- What are the balance of payments effects due to domestic and international shifts in supply and demand for its products?
- What plants or firms are likely to have to shut down or curtail production?
- What are the industry-wide or regional dislocation impacts?
- What are the effects on the industry's suppliers and consumers?
- What is the anticipated impact on employment? Are such effects likely to be concentrated in specific regions of the country?

These and other important economic questions must be resolved before an effective system and schedule of environmental controls can be finally established for specified types of industries.

In an effort to begin to provide answers required, the Council on Environmental Quality is carrying out a series of microeconomic studies aimed at evaluating the economic impact of environmental controls on major industries. One such industry is the fruit and vegetable canning and freezing industry.

The need for such information is urgent and the time available for such research is limited. As a consequence, it has been necessary to depend on secondary sources of published data and to review and adapt the results of existing studies related to the fruit and vegetable canning and freezing industries insofar as such studies were applicable to the questions posed by this project.

A. General Approach

To determine the economic impact of pollution abatement controls on the fruit and vegetable canning and freezing industries in aggregate, it is first necessary to assess expected differential impacts among firms within these industries. The general approach pursued is, therefore, to evaluate microeconomic relationships among representative firms within the fruit and vegetable processing industries as a first step; and, second, to project macroeconomic impacts based upon the expected impacts at the microeconomic level.

In order both to select "representative" processing plant operations within the fruit and vegetable processing industries and to evaluate probable industry-wide changes given expected changes for representative firms, it is essential to become thoroughly familiar with overall industry characteristics. The major purpose in Part II of this report is, therefore, to develop requisite background characteristics of the industry.

Following development of background information, emphasis is then directed toward development of methodology for microeconomic analysis and application of impact analysis as reported in Part III.

B. Acknowledgments

The authors would like to recognize the valuable assistance received from those who generously contributed of their time, ideas and made available information relevant to the project. An attempt will not be made to list the names of all individuals contributed but major organizations and their area of contribution, along with the principal authors of this report, are listed below.

Special thanks are due the National Canners Association of Washington, D.C. and the Laboratory at Berkeley, California, who contributed detailed industry statistics and documented data consolidated from a sample of canning firms.

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II. DEMAND CHARACTERISTICS OF THE FRUIT AND VEGETABLE INDUSTRY

The demand for processed, canned or frozen fruits and vegetables centers on a nation-wide market of consumers served mainly through retail food stores. Secondary, but nevertheless important, markets are found among institutional food purveyors (hotels, restaurants, in-plant feeding, schools, etc.), governmental purchases for military, school lunch and needy persons subsistence programs and purchases by further processors who use processed fruits and vegetables in the manufacture of prepared dinners and other convenience foods. For some products, mainly fruits, there exists an important export market.

Long-run changes in demand for processed fruits and vegetables are affected by gradual changes in dietary patterns and preferences of consumers and by technological processes which improve the availability and convenience of these foods for the consumer.

Short-run changes in demand are influenced by seasonal and year-to-year variations in production of fruits and vegetables for processing and for fresh use. Carry-over stocks of canned and frozen products are important in relation to short-run demands, but in the long run the entire pack of both canned and frozen products ultimately moves into consumption.

The analysis of the characteristics of the demand for canned and frozen fruits, vegetables and fruit juices involves the consideration of the several factors which influence this demand, including:

- Products and substitute products
- Size, location and relative importance of markets
 - Total market demand
 - Per capita consumption
 - International markets
 - Government purchases
- Distribution systems
- Recent market trends
 - Volume
 - Price
- Market competition
- Governmental influences

A. Products and Substitute Products

1. Products - Two Standard Industrial Classification industries are included in this analysis:

SIC 2033 Canned Fruits, Vegetables, Preserves, Jams and Jellies

Establishments primarily engaged in canning fruits and vegetables, and fruit and vegetable juices; and in manufacturing catsup and similar tomato sauces, preserves, jams and jellies. However, the analysis is limited to basic canning operations for fruits, vegetables and basic fruit and vegetable juices. No consideration is given to preserves, jams and jellies as these are usually secondary processing industries.

Data are maintained by the National Canners Association on 27 vegetable products and 29 fruit and fruit juice products. However, because of the limited time available for this study, the products analyzed were limited to those of greatest importance in terms of volume packed. Included were the following canned products:

Canned vegetables and juices

Tomatoes - whole peeled
 catsup & chili sauce
 puree
 juice
Snap beans (green beans)
Sweet corn
Peas, sweet green
Sauerkraut
Beets
Spinach
Mixed vegetables

Canned fruits and juices

Apples
Apple sauce
Peaches, cling
Pears, Bartlett
Apricots
Fruit cocktail
Grapefruit sections
Apple juice
Orange juice
Grapefruit juice
Pineapple juice

SIC 2037 Frozen Fruits, Fruit Juices, Vegetables and Specialties

Establishments primarily engaged in quick freezing and cold packing (freezing) fruits, fruit juices, vegetables and specialties. However, the analysis is again limited to basic fruit and vegetable freezing operations and manufacture of specialty items (frozen dinners, boxed goods, etc.) is omitted.

Data are maintained by the American Frozen Food Institute on 29 frozen vegetables, 21 frozen fruits and 8 frozen juices. Analysis was limited again to the most important products, which include:

Frozen vegetables

Snap beans (green beans)
Lima beans (baby & fordhook)
Sweet corn
Peas
Spinach
Broccoli
Brussels sprouts
Potato products

Frozen fruits and fruit juices

Strawberries
Concentrated orange juice
Cherries, RSP
Apples and sauce
Peaches
Blueberries
Raspberries, red
Blackberries

2. Substitute Products - The principal substitutes for canned and frozen fruits, vegetables and juices are fresh fruits and vegetables. Although fresh products substitute for both canned and frozen forms of the same product, the substitution relationship between the fresh and frozen product is usually closer since the canned product is often cooked and may have seasoning (salt, etc.) or sweetness (e. g., peaches in heavy syrup) added.

Development of new fresh production areas coupled with the improvements which have occurred in truck, rail and air transport, plus new technology in fresh product preparation, packaging and refrigeration, now make it possible to buy fresh products nearly the year around throughout the United States. However, out-of-season fresh products must be transported greater distances (sometimes from Mexico, Central or South America) or must be produced under hot house conditions in colder climates. The result is higher prices and consumers turn to frozen or canned forms to save money. However, price is not the only consideration influencing the consumer in her choice between fresh and processed fruits and vegetables. Many canned or frozen products offer greater convenience, more consistent quality and preferred flavor for certain uses. Canned and frozen products are easier to keep on hand on the shelf or in the freezer and this gives the housewife a greater variety available in her home at any given time than would be possible if she were entirely dependent on fresh products.

There are some substitution relationships between canned and frozen vegetables and other classes of foods. Canned or frozen fruit can, and does, substitute as a dessert for such items as ice cream, cakes or puddings. As dietary habits have changed (away from fats, oils and heavy desserts), there has been some substitution of fruits and vegetables, in terms of diet composition. However, this relationship is not close.

The substitution relationship between fresh and processed fruits or vegetables is measured by the formula

$$E_c = \frac{\Delta Q_1 \cdot P_2}{\Delta P_2 \cdot Q_1} \quad \text{where}$$

E_c = coefficient of cross elasticity

Δ = change

P_2 = price of the fresh product

Q_1 = quantity of the canned or frozen substitute

In general, the nearer the coefficient of cross elasticity approaches 1.00, the more closely the products substitute for each other.

In a study recently completed by Agri for the Ministry of Agriculture, Government of Mexico,^{1/} Wissman and Mennem found the following cross elasticities between winter vegetables and canned or frozen products.

<u>Fresh price - canned quantities</u>	<u>Cross elasticity</u>
Asparagus	+ .12
Beans	+ .20
Carrots	+ .22
Corn	+ .89
<u>Fresh price - frozen quantities</u>	
Beans	+ .32
Asparagus	+ .12
Broccoli	+ .22
Strawberries	+ .14

From these data, it is seen that although there is a degree of substitutability present, it is not close.

There is undoubtedly greater substitution between frozen and canned fruits and vegetables than between fresh and processed. However, there is still a significant difference in the minds of consumers between these two processed forms.

^{1/} Wissman, D. J. and Gary M. Mennem, "Demand for Mexican Fresh Fruits and Vegetables in the Central United States," Agri Report P-491, June 1971.

Although there would be some shift from processed to fresh consumption of fruits or vegetables if processing costs were increased by increased costs of environmental controls, the shift would not appear to be so great as to be a major factor adversely affecting the consumption of these products.

B. Size, Location and Relative Importance of Markets

Canned and frozen fruits, vegetables and juices are products sold in every city and town throughout the United States. The market is truly nationwide and although there are some regional differences in consumption patterns, the market is roughly proportional to the distribution of population.

1. Total Demand

Although there is normally some carry-over of pack from one packing season to the next, the total volume packed is the best indicator of aggregate demand for these products.

Canned Vegetables - Table II-1 shows the total pack of canned vegetables for 1969-70 and estimated data for 1970-71. Complete data for all products are not yet available for the 1970-71 pack year.

Total canned vegetable pack in the 1969-70 pack year was approximately 326,474,000 cases (24/303 can equivalents) and estimated pack for 1970-71 is 325,596,000 cases. This compares with an average pack of 323,641,000 cases over the period 1961-1970. Thus, it is seen that the pack of canned vegetables has remained relatively stable during the past ten years (Exhibit II-1).

Although pack data are reported for 27 vegetable products, four products account for over 70 percent of the annual pack. In 1969-70 these were as follows: tomato products (including whole peeled tomatoes, juice, catsup, chili sauce and puree)--34.4 percent, sweet corn--15.1 percent, green (snap) beans--13.0 percent and green peas--9.8 percent.

Canned fruits and fruit juices - Table II-2 shows the total pack for canned fruits and fruit juices for 1969-70 and estimated 1970-71 data. Again, complete pack data for 1970-71 are not yet available.

Total pack of canned fruits and fruit juices for 1969-70 was 232,084,000 actual cases, and estimated pack for 1970-71 is 208,113 cases. Pack data for 29 fruit and fruit juice items were reported. These packs compare with an average pack of 199,588,000 cases during the 1961-70 period and the

Table II-1. Summary of Canned Vegetable Packs, 1969 and 1970 ^{1/}

Product,	Pack, 000 Cases 24/303 cans	
	1969-70	Estimated 1970-71
Tomatoes & Tomato products - Total	112,148	120,200
Tomatoes, whole peeled	32,036	39,017
Tomato juice	33,653	35,952
Tomato catsup	37,780 ^{2/}	37,780 ^{2/}
Tomato chili sauce	1,665	1,504
Tomato puree	7,014	5,947
Corn, Sweet	49,387	46,995
Beans, Green	42,481	43,189
Peas, Green	32,071	28,697
Potatoes, Sweet	12,499	12,499 ^{3/}
Beets	11,339	11,339 ^{3/}
Sauerkraut	10,569	10,569 ^{3/}
Asparagus	6,817	5,972
Spinach	6,577	7,270
Potatoes, White	6,110	6,110 ^{3/}
Carrots	5,463	5,463 ^{3/}
Pumpkin and Squash	5,244	3,973
Beans, Wax	4,858	4,382
Mixed Vegetables	4,357	4,367
Beans, Lima	3,596	2,776
Leafy greens	3,440	3,527
Peas, field	2,946	2,393
Carrot and Peas	2,438	2,086
Mushrooms	2,032 ^{4/}	2,032 ^{4/}
Pimentos	876	627
Okra and tomatoes	475	348
Succotash	383	339
Okra	368	443
Total	326,474	325,596

^{1/} Source: Division of Statistics, National Canners Association

^{2/} 1967 pack, data not available since that time

^{3/} 1969 pack data not available for 1970

^{4/} 1968 pack, data not available for 1969

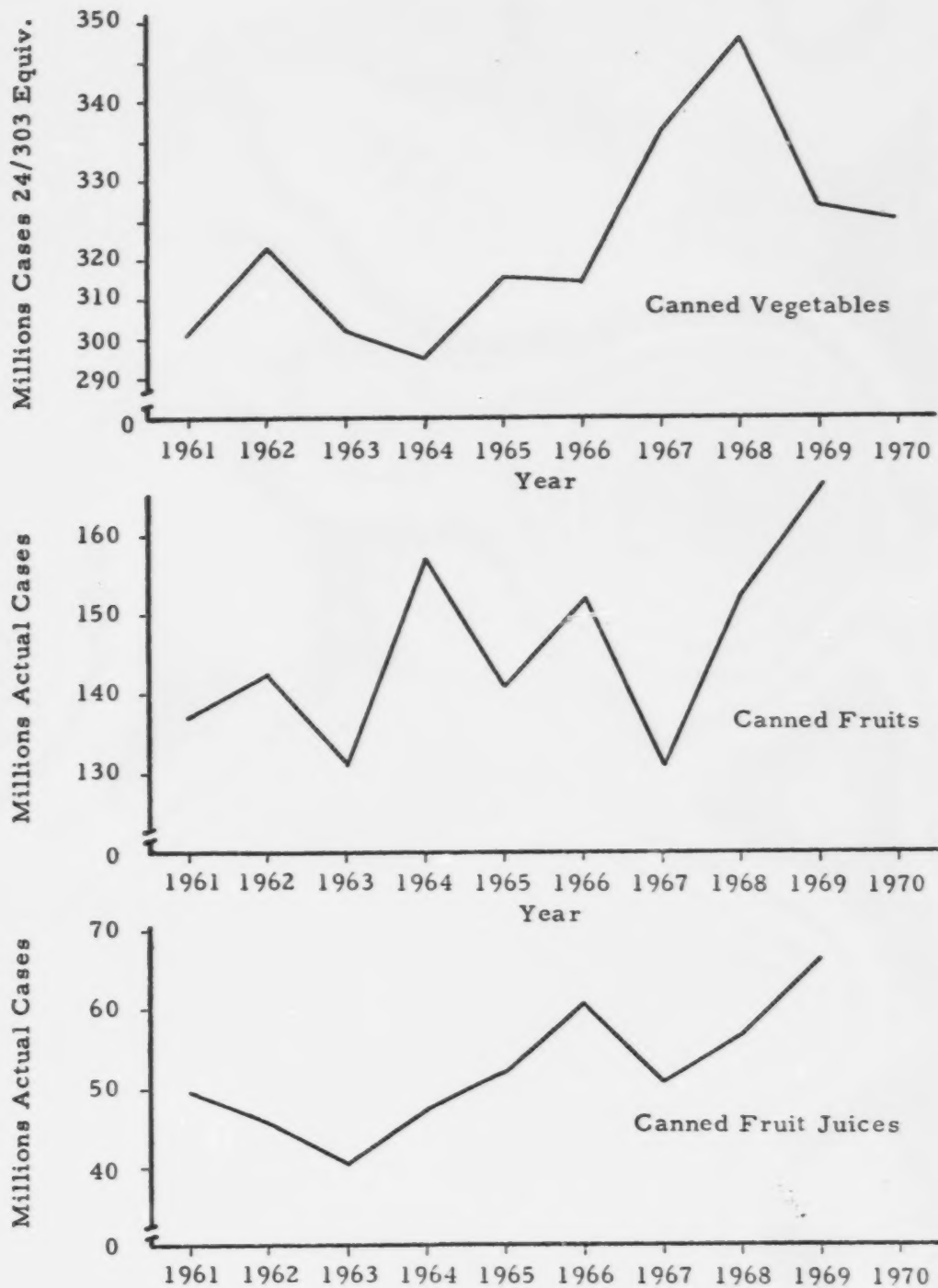


Exhibit II-1. Trends in the Pack of Canned Vegetables, Fruits and Fruit Juices.

Source: Statistical Division, National Cannery Association

Table II-2. Summary of Canned Fruit and Fruit Juice Pack 1969 and 1970 ^{1/}

Product	Pack, 000 Actual Cases	
	1969-70	Estimated 1970-71
Peaches	43,645	33,096
Apple Sauce	27,553	27,553 ^{2/}
Pineapple	24,256	24,256 ^{2/}
Fruit Cocktail	23,909	18,319
Grapefruit Juice	20,080	20,080
Orange Juice	17,082	17,080
Pears	13,597	10,906
Pineapple Juice	13,558	13,558
Apple Juice	13,503	13,503
Apricots	7,126	4,654
Cranberry Sauce	6,692	7,394
Grapefruit Segments	3,726	3,726 ^{2/}
Apples	3,128	3,128 ^{2/}
Other Fruits and Juices	14,229	10,860
Total	232,084	208,113

^{1/} Source: Division of Statistics, National Canners Association

^{2/} 1969-70 pack, 1970-71 data not yet available.

1968, 1969 and 1970 packs were the largest of the 10-year period. Four fruits accounted for 51.5 percent of the total as follows: peaches--18.8 percent, apple sauce--11.9 percent, pineapple--10.5 percent and fruit cocktail--10.3 percent.

Four fruit juices accounted for an additional 27.7 percent of total 1969-70 pack, grapefruit juice--8.7 percent, orange juice--7.4 percent, pineapple juice--5.8 percent and apple juice--5.8 percent.

Frozen Vegetables - Table II-3 shows the total pack of frozen vegetables for the years 1969 and 1970. The pack in 1970 was 4,472,213,000 pounds, more than double the pack in 1961 (2,116,041,000 lbs.) and nearly 50 percent above the 1961-70 average (3,123,665,000 lbs.). Frozen vegetables have evidenced a steady increase during this period. (Exhibit II-2).

In terms of total tonnage produced, potato products represent over half of the total volume, 2.4 billion pounds in 1970 compared to a total pack of 4.5 billion pounds.

Other major vegetable items frozen included: peas

peas	344 million lbs.	7.7% of pack
corn, cut	216 million lbs.	4.8% of pack
beans	212 million lbs.	4.7% of pack

Other important vegetables for freezing are broccoli, carrots and spinach.

Frozen Fruits and Fruit Juices - Frozen fruits and fruit juices do not show the consistent upward trend in volume that exists for frozen vegetables (Exhibit II-2).

Table II-4 shows that four products dominate the pack of frozen fruits and juices. Frozen concentrated orange juice pack is more than equal to the entire pack of all other frozen fruits and juices and in 1970 amounted to 126,402,000 gallons or 1,251,379,000 pounds as compared to a total pack of 620,688,000 pounds for all other frozen fruits. Among frozen fruits, strawberries--201.6 million pounds (32% of total frozen fruit pack) is by far the dominant product. Other important frozen fruits are cherries and apples and apple sauce.

2. Changes in Demand - Specific Products

Over the past ten years (1961-1970) the relative demand positions of individual products have changed. The demand (pack) for certain products has grown rapidly whereas the demand for others has grown less rapidly or, in some cases, actually decreased.

Canned Products - A simple comparison of 1961 and 1970 packs for canned products shows the following changes.

Table II-3. Summary of frozen vegetable packs, 1969 and 1970 ^{1/}

Product	Pack (000 lbs.)	
	1969	1970
Potato products	2,048,408	2,404,389
Peas	367,323	344,520
Corn, cut	289,268	216,097
Beans, green and wax	197,799	212,362
Broccoli	153,784	185,157
Carrots	150,945	173,054
Spinach	107,182	145,694
Mixed vegetables	101,400	110,333
Beans, lima, baby	82,562	73,012
Corn-on-cob	73,914	80,889
Cauliflower	69,744	59,782
Beans, lima, fordhook	55,792	36,844
Brussels sprouts	40,083	42,663
Other vegetables	317,078	387,417
Total	4,055,282	4,472,213

^{1/} Source: American Frozen Food Institute

Table II-4. Summary of frozen fruit and fruit juice packs,
1969 and 1970 ^{1/}

Product	Pack (000 lbs.)	
	1969	1970
Strawberries	178,693	201,572
Cherries RSP	140,688	121,271
Apples and sauce	122,293 ^{2/}	100,370 ^{2/}
Orange juice, conc.	108,043 ^{2/}	126,402 ^{2/}
Peaches	53,527	47,471
Blueberries	37,663	21,836
Raspberries, red	27,657	25,409
Blackberries	27,184	29,186
Other fruits, berries and juices	90,578	73,573
Total	678,283	620,688

^{1/} Source: American Frozen Food Institute

^{2/} Thousands of gallons, not included in pack totals,
equals 1,069,625,000 lbs. 1969
1,251,379,000 lbs. 1970

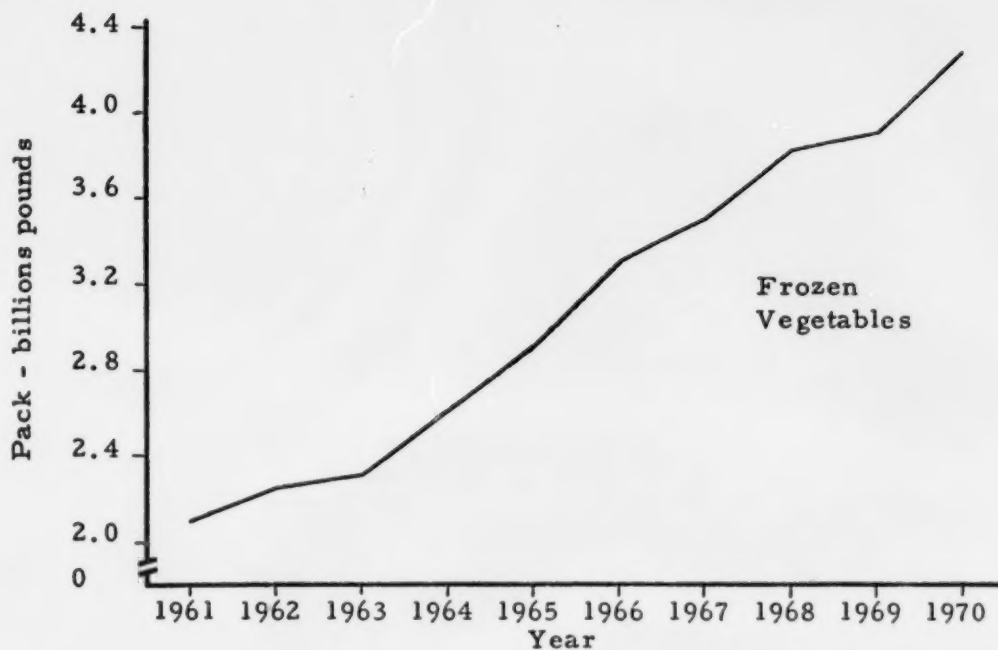


Exhibit II-2. Trends in the Pack of Frozen Fruits and Vegetables, United States, 1961-1970

Source: American Frozen Food Institute

<u>Canned Vegetables</u>		<u>Canned Fruits and Juices</u>	
<u>Product</u>	<u>% change 1961-70</u>	<u>Product</u>	<u>% change 1961-70</u>
Mixed vegetables	+ 80%	Grapefruit juice	+ 112%
Carrots and peas	+ 44	Apple juice	+ 99
Tomato catsup	+ 42	Apple sauce	+ 46
White potatoes	+ 33	Peaches	+ 25
Chili sauce	+ 24	Fruit cocktail	+ 24
Pumpkins and squash	+ 21	Pears	+ 20
Wax beans	+ 20	Pineapple	+ 16
Green beans	+ 17	Cranberry sauce	0
Tomato puree	+ 8	Apricots	0
Sauerkraut	+ 7	Pineapple juice	0
Beets	+ 7	Orange juice	0
Corn, sweet	0	Grapefruit segments	- 20
Peas, green	- 1	Apples	- 22
Tomatoes, whole peeled	- 6		
Tomato juice	- 13		
Asparagus	- 18		

The most spectacular canned vegetable changes seemed to have come in convenience items such as mixed vegetables and carrots and peas and in tomato catsup and sauce. Both are, in part, apparently the result of changes in eating habits of the American consumer. In canned fruits and juices, it is worth noting that the two greatest increases were juice products -- grapefruit and apple. Canned orange juice failed to increase as its use is being replaced by frozen orange concentrate.

Frozen Products - A similar comparison was made for frozen vegetables, fruits and juices and showed the following changes:

<u>Frozen Vegetables</u>		<u>Frozen Fruits and Juices</u>	
<u>Product</u>	<u>% change 1961-70</u>	<u>Product</u>	<u>% change 1961-70</u>
Corn-on-cob	+ 574%	Orange juice, conc.	+ 50
Potato products	+ 315	Apples & apple sauce	+ 25
Carrots	+ 187	Blackberries	+ 20
Mixed vegetables	+ 102	Raspberries, red	+ 10
Broccoli	+ 52	Strawberries	+ 9
Cauliflower	+ 45	Blueberries	0
Corn, cut	+ 28	Cherries, RSP	- 35
Spinach	+ 25		
Beans, green & wax	+ 17		
Brussels sprouts	+ 7		
Peas	0		
Lima beans, baby	0		
Lima beans, fordhook	- 20		

While corn-on-cob increased greatly during this period, the percentage increase is somewhat misleading since this product started from a low volume in 1961. The increase in frozen potato products reflects both new products and new technology and a change in eating habits toward more french fries, etc., plus a growing demand for convenience foods.

Frozen concentrated orange juice increased by 50 percent and has become the standard American breakfast juice. Although an increase in canned grapefruit juice was seen, canned tomato juice decreased and no increase was seen for canned orange juice.

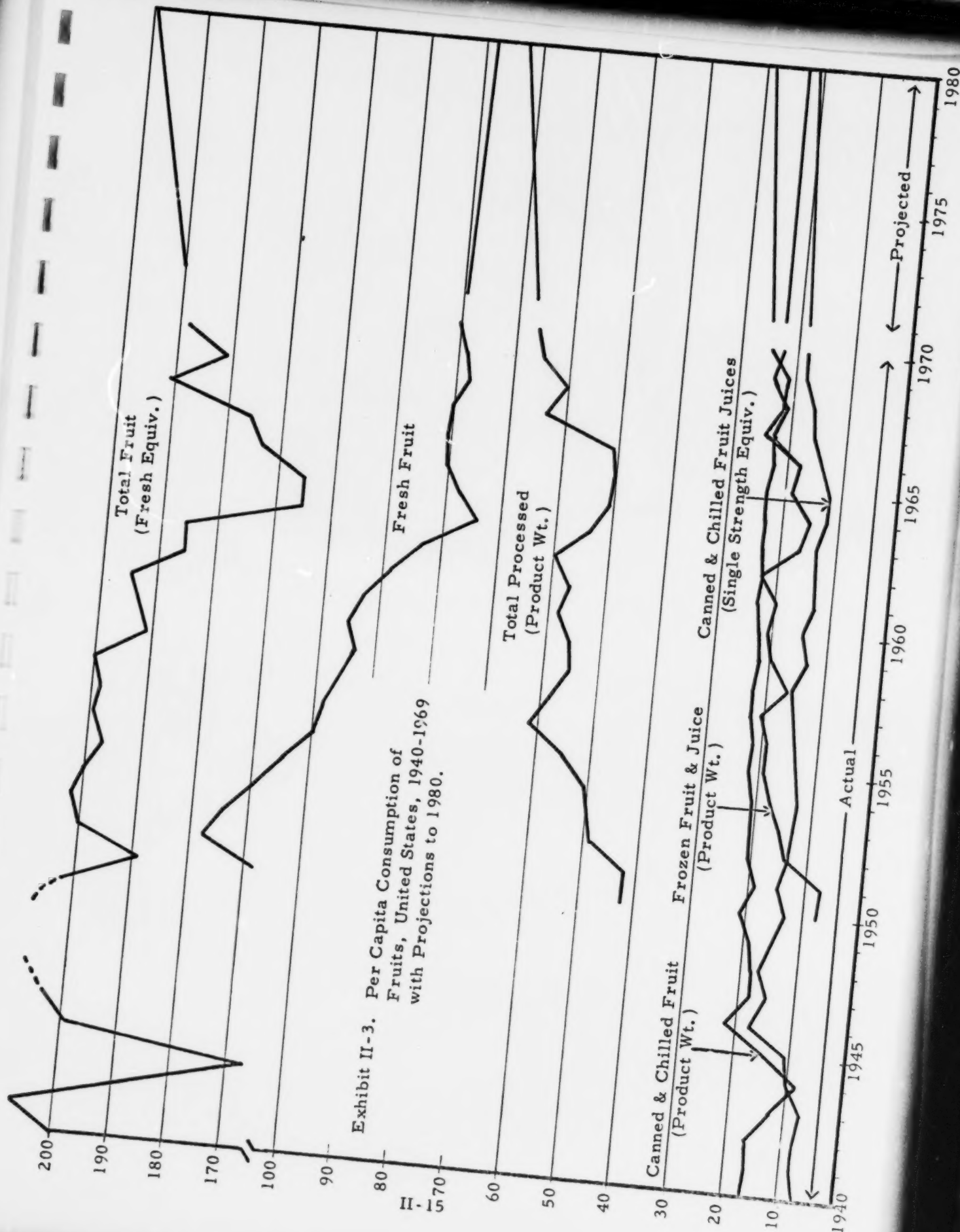
3. Per Capita Consumption of Fruits and Vegetables

Some very distinct changes have occurred in the patterns of consumption of fruit and vegetables by the American consumer over the past two decades. These patterns can best be examined by viewing past utilization trends. Changes in consumption patterns generally reflect the interaction of various factors such as production, price, rising income, population, new food styles, and more casual and informal living.

Fruits - After a record high per capita consumption of all fruits in 1946 of 225 pounds (fresh equivalent) -- partially the result of restocking pantry shelves and retail stores following the wartime scarcity -- consumption leveled off to approximately 200 pounds in the early 50's. During the last two decades annual per capita consumption of all fruits combined fluctuated from a high of 203 pounds in 1952 to a low of 165 pounds in 1964 (Exhibit II-3). Citrus accounted for 40 to 50 percent of per capita consumption of all fruits. Total consumption is expected to increase slightly by 1980 to about 200 to 210 pounds of fresh equivalent primarily reflecting an increase in processed citrus.

Exhibit II-3 also shows the per capita consumption of canned and frozen fruits and juices as well as total fruit processed (excluding dried) on a product weight basis. Total processed fruit has increased steadily from about 43 pounds per capita in 1950 to the present level of 67 pounds in 1970. According to USDA Specialists, per capita consumption of all processed fruit can be expected to climb to about 70-75 pounds by 1980. The level of consumption of canned fruit has averaged about 22 to 24 pounds per person during the past two decades and is expected to hold at about the present level.

Canned and chilled juices have increased from about 13 pounds to the current level of 18-19 pounds and will continue to gain slightly over the next decade.



Frozen fruit, mainly strawberries and other berries, maintain a relatively small share of the total market at about three to four pounds per person and will probably remain at that level. Frozen juices (single strength equivalent), however, have been a rapid gainer from the early fifties when they first became popular. Consumption has increased from about 5 pounds to over 20 pounds in 1970. Growth in the per capita consumption of frozen juices can be expected to continue through 1980.

Vegetables - The consumption of vegetables has remained fairly constant over the past twenty years at about 200 pounds (Exhibit II-4). Since 1965, per capita consumption has increased by approximately 12 pounds; however, that rate of increase is not expected to continue as total consumption for the year 1980 is estimated at about 222 pounds per person.

During these same years a gradual increase in the consumption of canned and frozen vegetables has occurred. Since total consumption did not appreciably change, this increase has been at the expense of the fresh produce share of the market. The convenience of using processed products, plus their ability to compete on terms of quality and price has stimulated increases in the consumption of both frozen and canned vegetables.

Canned vegetable consumption climbed from 77 pounds per capita in 1950 to 81 pounds in 1960. During the 1960's, canned consumption increased to 95 pounds.^{1/} At the same time, frozen consumption has climbed steadily from the early 1950's to about 20 pounds in 1969. Fresh consumption, however, decreased from about 115 pounds in 1950 to 105 in 1960. Fresh consumption has further declined during the 1960's. The current level is about 98 pounds.

It is believed by USDA specialists and others that the major shift to canned and frozen is leveling out. Although these will increase in total canned and frozen from the present 114 pounds to about 126, it will not be at the expense of fresh but represent an increase in total consumption. Fresh is projected to remain at about the same level with only a slight decrease from 98 to 96 pounds over the next decade.

^{1/} The canned and frozen consumption estimates are based on the commonly used "fresh equivalent basis." This means that the 94 pounds of canned (fresh equivalent) reported for 1969 would actually amount to 51 pounds of consumption (about 54 percent). For frozen vegetables it would amount to about 9 pounds of actual consumption for 20 pounds of fresh equivalent (44 percent).

Pounds

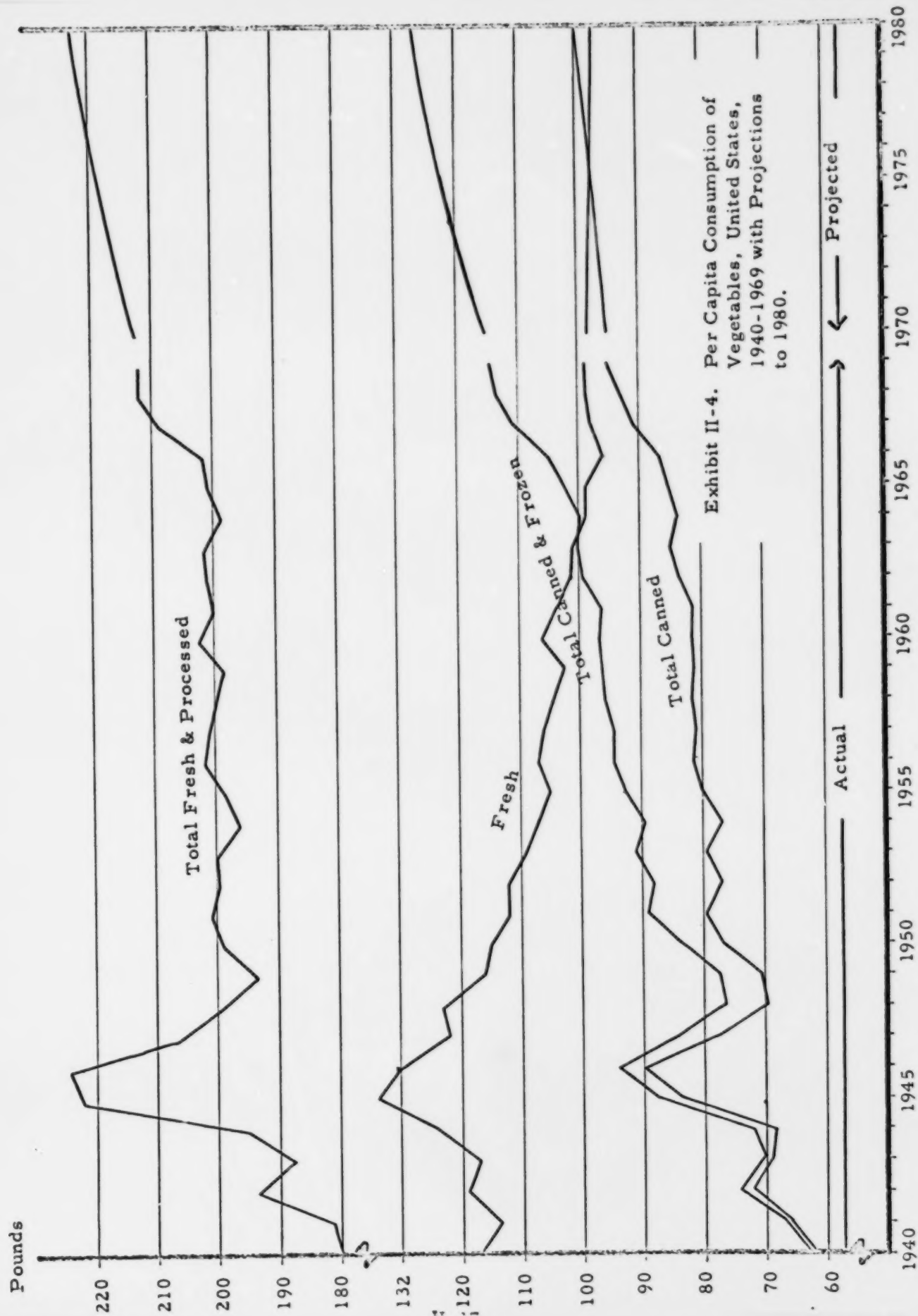


Exhibit II-4. Per Capita Consumption of Vegetables, United States, 1940-1969 with Projections to 1980.

4. International Trade

Exports - Although there is an appreciable year-to-year variation in the export of individual fruit and vegetable items, little trend is apparent over the last four years in U.S. exports of canned and frozen fruit, vegetable and juice products. The following data indicate the export volumes for general product categories, 1967-1970.

<u>Product</u>	<u>Unit</u>	<u>1967</u>	<u>Export volume</u>		<u>1970</u>
			<u>1968</u>	<u>1969</u>	
Canned fruits	(000 lbs)	354,809	302,234	439,990	396,261
Canned vegetables	(000 lbs)	100,261	89,764	107,384	102,587
Canned juices	(000 gal)	33,115	29,992	28,199	32,135
Frozen juices	(000 gal)	5,419	5,162	5,437	7,815
Frozen fruits & veg.	(000 lbs)	32,377	32,276	34,351	30,342

These data do show the dominance of canned fruits in the export trade. While the pack of canned vegetables in the United States is approximately twice that of canned fruits, exports of canned fruits equal approximately three times the volume of canned vegetables.

Exports of canned vegetables, fruits and juices are shown in Table II-5 for 1970. As can be seen, exports of canned vegetables are not significant, in terms of total pack, for any item. Canada is the major export market for most products, although Japan is first for sweet corn and Hong Kong is an important market for both corn and tomato catsup.

The situation is different for canned fruits. Export markets are relatively important, taking 14.7 percent of the fruit cocktail pack, 14.5 percent (1969) of the cherry pack, 12.6 percent of the peach pack and 9.1 percent of the pineapple pack. West Germany and other Western European countries plus Canada are the major export markets for canned fruit products.

Much the same situation exists for canned fruit juices. Export markets take 41.5 percent of the hot-pack orange juice. The U.S. market has turned largely toward frozen concentrated orange juice, but there is still a good market for hot-pack juice in Canada, Western Europe and Sweden. A good export market (18.5 percent of total pack) also exists for canned grapefruit juice and 9.8 percent of the pack of canned pineapple juice is exported. In contrast, only 2.8 percent of the pack of canned tomato juice is exported.

Table II-5. Exports of canned and frozen vegetables, fruits
and juices, 1970

Product	Unit	1970 Exports	% of Pack	Major Countries
<u>Canned vegetables</u>				
Tomatoes	000 lb.	19,146	2.4	Canada
Corn	000 lb.	15,574	1.3	Japan
				Hong Kong
				Denmark
				Sweden
				W. Germany
				France
				Nigeria
				Switzerland
Tomato puree and conc.	000 lb.	9,994	4.1	United Kingdom
Beans, nec	000 lb.	7,638	0.7	Canada
				Dominican Republic
				Panama
				Canada
Asparagus	000 lb.	7,486	4.4	Denmark
				Sweden
				Belgium-Lux
				W. Germany
				United Kingdom
Tom. catsup and chili sauce	000 lb.	6,967	0.7	Hong Kong
				Canada
Frozen vegetables (all)	000 lb.	25,798	0.6	Canada
				United Kingdom
				Denmark
				Sweden
				Bermuda
				Australia
				W. Germany

Table II-5. Exports of canned and frozen vegetables, fruits and juices, 1970 (continued)

Product	Unit	1970 Exports	% of Pack	Major Countries
<u>Canned fruits</u>				
Peaches	000 lb.	165,573	12.6	W. Germany Canada Switzerland Belgium-Lux. Sweden Netherlands Austria
Fruit cocktail	000 lb.	108,773	14.7	Canada W. Germany Belgium-Lux.
Pineapple	000 lb.	68,648	9.1	W. Germany Belgium-Lux. France Canada Netherlands Switzerland
Cherries (1969)	000 lb.	15,571	14.5	W. Germany Belgium-Lux. Netherlands
Pears	000 lb.	8,743	2.1	Rep. South Africa W. Germany Canada
<u>Canned juices</u>				
Pineapple	000 gal.	3,749	9.8	Canada
Grapefruit, single str.	000 gal.	5,990	18.5	Canada
Orange, single str. and conc.	000 gal.	12,632	41.5	Canada Sweden France W. Germany
Tomato	000 gal.	1,589	2.8	Japan Saudi Arabia Canada

Table II-5. Exports of canned and frozen vegetables, fruits
and juices, 1970 (continued)

Product	Unit	1970 Exports	% of Pack	Major Countries
<u>Frozen juices</u>				
Orange, froz. conc.	000 gal.	6,097	5.6	Canada Sweden United Kingdom W. Germany
Grapefruit, froz. conc.	000 gal.	939	15.9	Canada Australia W. Germany

Frozen concentrated orange juice is the principal frozen product exported. Over six million gallons (60 million pounds) were exported in 1970, a volume greater than all other frozen fruit, vegetable and juice products. Canada, Sweden, United Kingdom, and West Germany were the principal export markets served. However, in terms of total U.S. pack, exports of frozen, concentrated orange juice accounted for only 5.6 percent of total pack.

The export market for frozen concentrated grapefruit juice, while smaller than for orange juice (939,000 gallons) accounted for 15.9 percent of total pack.

Exports of frozen vegetables in 1970 were 25,798,000 pounds, but accounted for only 0.6 percent of total pack.

While exports of canned and frozen fruit, vegetable and juice products were valued at over \$143,000,000 in 1970 they still represent but a small percentage of the total pack of these products. There are individual exceptions such as canned, hot pack orange and grapefruit juice, canned cherries, fruit cocktail and peaches where important export markets exist. However, for most fruits, vegetables and juices, either canned or frozen, the private, domestic market is still the dominant outlet.

Imports - The greatest competition with regard to imports of fruits and vegetables is from the importation of fresh products. Imports of processed fruits, vegetables and juices are primarily tropical or subtropical products not produced in the United States. However, for certain products, imports do constitute a major part of the total supply in the United States and do, therefore, compete directly with similar products processed by U.S. canners and freezers.

Imports of these products - volume, relation to U.S. pack and principal countries of origin - are shown in Table II-6.

Imports of apple and pear juice, mainly from Switzerland and France, in 1970 totaled 16.8 million gallons - equal to 45 percent of the U.S. pack.

Pineapple juice imports, 13.6 million gallons, were equal to 38 percent of the U.S. pack. Most of this import volume came from the Philippines. Canned pineapples imported from the Philippines, Taiwan, Mexico, Malaysia and Thailand equaled 32 percent of the U.S. pack.

Table II-6. United States' Imports of Canned and Frozen Fruit and Vegetable Products 1970, 1/

Product	Unit	Imports	% of U.S. Pack	Principal Countries of Origin
<u>Canned Fruit Juices</u>				
Apple and pear juice	000 gal.	16,800	45	Switzerland France Austria
Orange juice, conc.	000 gal.	1,461	5	Brazil
Pineapple juice	000 gal.	13,595	35	Philippines
<u>Canned & Frozen Fruits</u>				
Blueberries, frozen	000 lb.	11,099	29	Canada
Pineapples, canned	000 lb.	239,773	32	Philippines Taiwan Mexico Malaysia Thailand
Strawberries, frozen	000 lb.	109,738	61	Mexico
<u>Canned Vegetables</u>				
Tomatoes, paste & sauce	000 lb.	91,382	8	Portugal
Tomatoes, except paste and sauce	000 lb.	128,534	16	Italy Spain
Mushrooms, prep. pres ex. dried	000 lb.	24,808	50	Taiwan

Canada was a major supplier of frozen blueberries, equal to 29 percent of the U.S. pack, and Mexico exported nearly 110 million pounds of frozen strawberries to the United States, an amount equal to 61 percent of the U.S. pack.

Large quantities of canned mushrooms, nearly 25 million pounds, are received from Taiwan - equal to 50 percent of the U.S. pack.

Over 200 million pounds of tomatoes, paste and sauce, came into the United States in 1970, mainly from Italy, Portugal and Spain.

Although imports of canned and frozen fruits, vegetables and juices are relatively minor when compared to the total U.S. pack of these products, imports are important in competition with certain products. Most important are:

1. Frozen strawberries
2. Canned mushrooms
3. Canned apple and pear juice
4. Canned pineapple juice
5. Canned pineapples
6. Frozen blueberries

5. Government Purchases

Government purchases of canned and frozen fruits, vegetables and juices are made primarily to supply the requirements of the Armed Services, Veterans Administration, School Lunch Program and Needy Families Programs.

Canned Products - Although the volume of purchases varies substantially from year to year for specific canned fruit or vegetable items, there has been no consistent trend in the volume of government purchases (either up or down) for individual items or aggregate volume during the period 1966-67 - 1970-71. Total government purchases of canned products during the past five years were as follows:

<u>Year</u>	<u>All Vegetables</u> 000/Cases 24/303	<u>All Fruits</u> 000/Cases 24/2 1/2	<u>All Juices</u> 000/Cases 24/2
1966-67	16,437	6,337	4,409
1967-68	16,355	9,621	9,101
1968-69	12,475	5,300	3,272
1969-70	18,302	5,574	8,218
1970-71	13,167	7,142	8,050

Government purchases of major canned vegetable, fruit and juice products for 1970-71 are shown in Table II-7.

The principal canned vegetables purchased in volume were tomatoes and tomato paste, green beans and sweet corn. In relation to total pack, government purchases of canned vegetables varied between a low of 1.6 percent for sauerkraut and a high of 8.2 percent for tomatoes and tomato paste.

Only two canned fruits were purchased in large volumes -- peaches and applesauce. In relation to total pack, government purchases varied from a low of 1.9 percent for fruit cocktail to 7.8 percent of the total apricot pack.

Government purchases of canned juices were relatively more important in relation to total volume packed, accounting for 12.8 percent of the pack of apple juice, 11.8 percent of the pineapple juice and 11.4 percent of the canned orange juice pack.

Table II-7. Government Purchases, Canned Fruits, Vegetables
and Juices, 1970

Product	Unit	1970	Percent of 1969-70 Pack
		Government Purchases	
<u>Canned Vegetables</u>	000 cases 24/303		
Beans, green & wax	"	2,121	4.5
Beets	"	323	2.8
Catsup	"	1,072	2.8
Corn, Sweet	"	2,063	4.2
Potatoes, sweet	"	935	7.5
Sauerkraut	"	173	1.6
Spinach	"	134	2.0
Tomatoes & tomato paste	"	3,719	8.2
<u>Canned Fruits</u>	000 cases 24/2 1/2		
Apples	"	160	5.1
Applesauce	"	1,685	6.1
Apricots	"	553	7.8
Fruit cocktail	"	444	1.9
Grapefruit segments	"	235 (1969)	6.4
Peaches	"	2,201	5.0
Pears	"	582	4.3
Pineapple	"	861	3.5
<u>Canned Juices</u>	000 cases 24/2		
Apple juice	"	1,772	12.8
Grapefruit juice	"	291	1.5
Orange juice	"	1,942	11.4
Pineapple juice	"	1,610	11.8
Tomato juice	"	1,885	5.6

Sources: Division of Subsistence, Defense Supply Agency (Military)
Marketing Division for Subsistence, Veterans Adm. (Veterans Adm.)
U. S. Department of Agriculture (School Lunch & Needy Families)

In summary, government purchases of canned fruit and vegetable products are an important element of total market demand, but do not occupy a dominant position.

Frozen Products - There appears to be an increasing trend in military purchases of frozen vegetables, volume increasing from 67,981,000 lbs. in 1966-67 to 83,865,000 in 1970-71, largely the result of substantial increases in purchase of frozen potato items. However, no such trend appears for other frozen vegetables nor for frozen fruits or juices. Total government purchases of frozen vegetable, fruit and juice products during the past five years were as follows:

<u>Year</u>	<u>Frozen Vegetables</u> (000 lbs.)	<u>Frozen Fruits</u> (000 lbs.)	<u>Frozen Juices</u> (000 lbs.)
1966-67	67,981	24,895	24,460
1967-68	79,241	25,930	24,334
1968-69	72,592	23,883	18,750
1969-70	80,270	20,588	20,962
1970-71	83,865	19,227	18,321

Government purchases of major frozen vegetable, fruit and juice products for 1970-71 are shown in Table II-8. Potato products represent the greatest total volume, over 20 million pounds, but even so, government purchases represent only one percent of the total frozen pack of potato products. Other large volume items are mixed vegetables, green beans, peas, corn and broccoli. In terms of relative importance, government purchases were most significant for mixed vegetables (8.9% of pack), Brussels sprouts (7.2%), asparagus (6.8%) and cauliflower (6.7%).

Principal frozen fruits purchased were strawberries (8,196,000 lbs.) and peaches (6,739,000 lbs.). Peaches were the only crop for which government purchases (12.5%) were a major part of the total sales.

Frozen concentrated orange juice goes mainly to the military subsistence and school lunch programs. Government purchases 1970-71 were 11,512,000 lbs., but this represented but 1.1% of the total pack of frozen concentrated orange juice.

In summary, as was true for government purchases of canned vegetables, fruits and juices, government purchases represent substantial product volumes for frozen products, but do not dominate in relation to total sales for specific products or volume in total.

Table II-8. Government Purchases of Frozen Foods, 1970

Product	1970 Government Purchases (000 lbs.)	Percent of 1969-70 Pack
<u>Frozen Vegetables</u>		
Asparagus	1,578.1	6.8
Beans, green & wax	8,972.7	4.5
Beans, lima	5,178.4	3.7
Broccoli	7,347.0	4.7
Brussels sprouts	2,884.5	7.2
Cauliflower	4,672.9	6.7
Corn	8,345.3	2.9
Peas	8,561.8	2.3
Potatoes	20,382.5	1.0
Spinach	4,298.2	4.0
Squash	426.2	2.5
Veg., mixed	9,029.6	8.9
<u>Frozen Fruits</u>		
Blueberries	441.2	1.2
Cherries	3,477.8	2.5
Peaches	6,739.1	12.5
Raspberries	226.6	0.8
Strawberries	8,196.1	4.6
<u>Frozen Fruit Juices</u>		
Grapefruit, conc.	2,721.9	4.8
Orange, conc.	11,512.4	1.1

Sources: Division of Subsistence, Defense Supply Agency (Military)
Marketing Division for Subsistence, Veterans Adm. (Veterans Adm.)
U. S. Department of Agriculture (School Lunch)

C. Recent Trends in Demand and Price

1. Demand Trends

As was discussed earlier in this chapter, annual pack data have been used to represent demand. Although pack and demand are not identical in a given year, ultimately pack is transferred to demand as it enters into consumption. Inventory adjustments may affect pack-stock relationships in a given year but ultimately nearly all vegetables and fruits packed enter into consumption. Although long-term adjustments in demand eventually influence the volume of a particular product packed, either up or down, annual variations in the pack of fruits and vegetables are more often the result of weather-associated influences on production. With the exception of a few products (e.g., cling peaches) covered by production control market orders, packers can do little to influence production in any given season. In bumper years raw product prices are low and the reverse is true in years of poor crops.

Tree and bush fruits are perennial crops and production changes are slow. Most vegetable crops are high-risk, speculative undertakings and production is highly susceptible to weather. In spite of the influence of production-associated factors on annual packs, pack data, when viewed over a period of time, are indicative of changes in demand for the products represented.

Canned Vegetables - The annual pack of major canned vegetables 1961-70 is shown in Exhibit II-5. Although there are substantial year-to-year variations in pack, certain trends are observable which over the ten-year period are demand associated. In summary, these trends are as follows:

Green beans	-	trend sharply upward
Tomato catsup	-	trend sharply upward
Sweet corn	-	trend moderately upward
Sweet potatoes	-	trend slightly upward
Beets	-	trend slightly upward
Peas	-	trend about constant
Spinach	-	trend about constant
Tomatoes	-	trend about constant
Tomato juice	-	trend sharply downward

Canned Fruits - Ten-year trends in the pack of eight major fruits are shown in Exhibit II-6. Again certain discernable trends in demand appear to exist as follows:

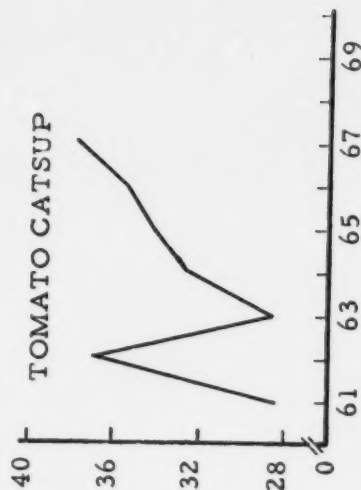
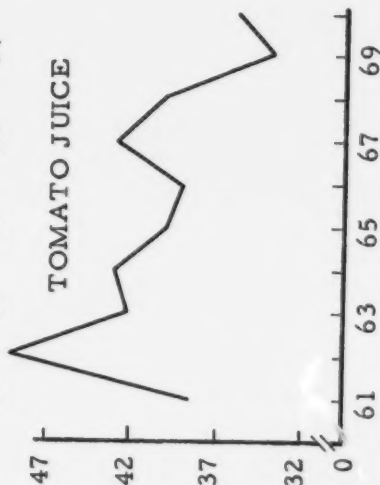
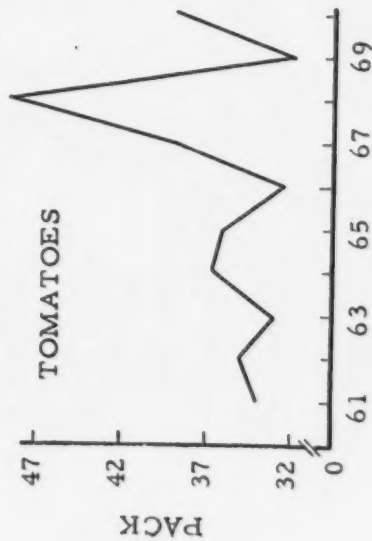
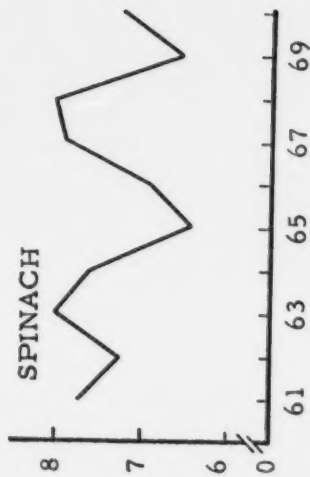
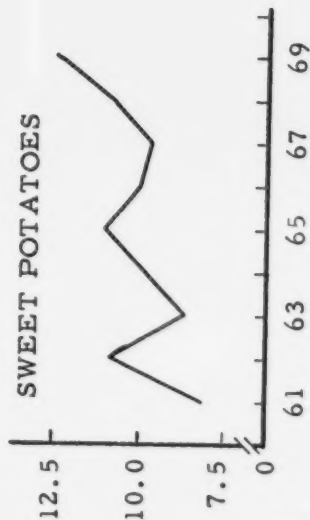
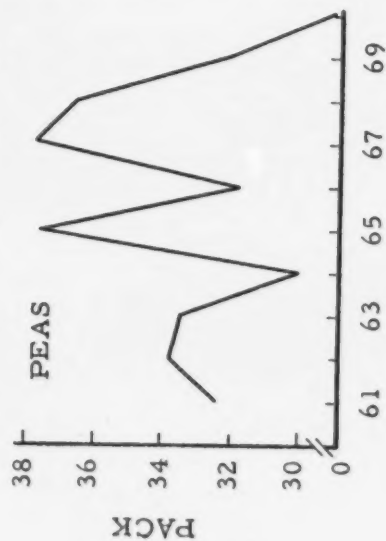
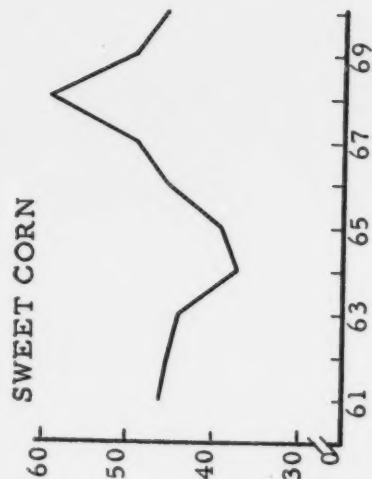
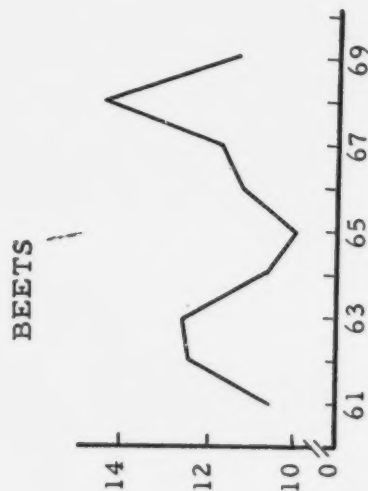
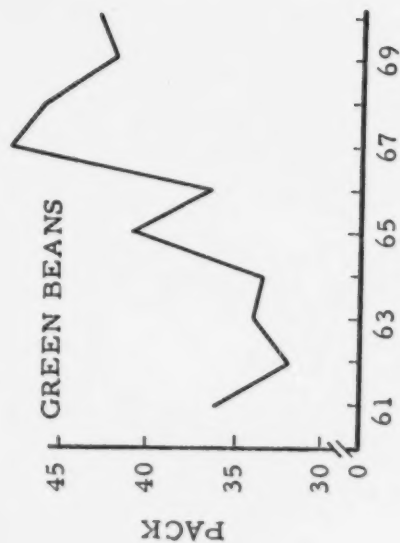


Exhibit II-5. Trends in Volume Packed, Canned Vegetables, Millions Cases 24/303 Equiv.
Source: National Cannery Association.

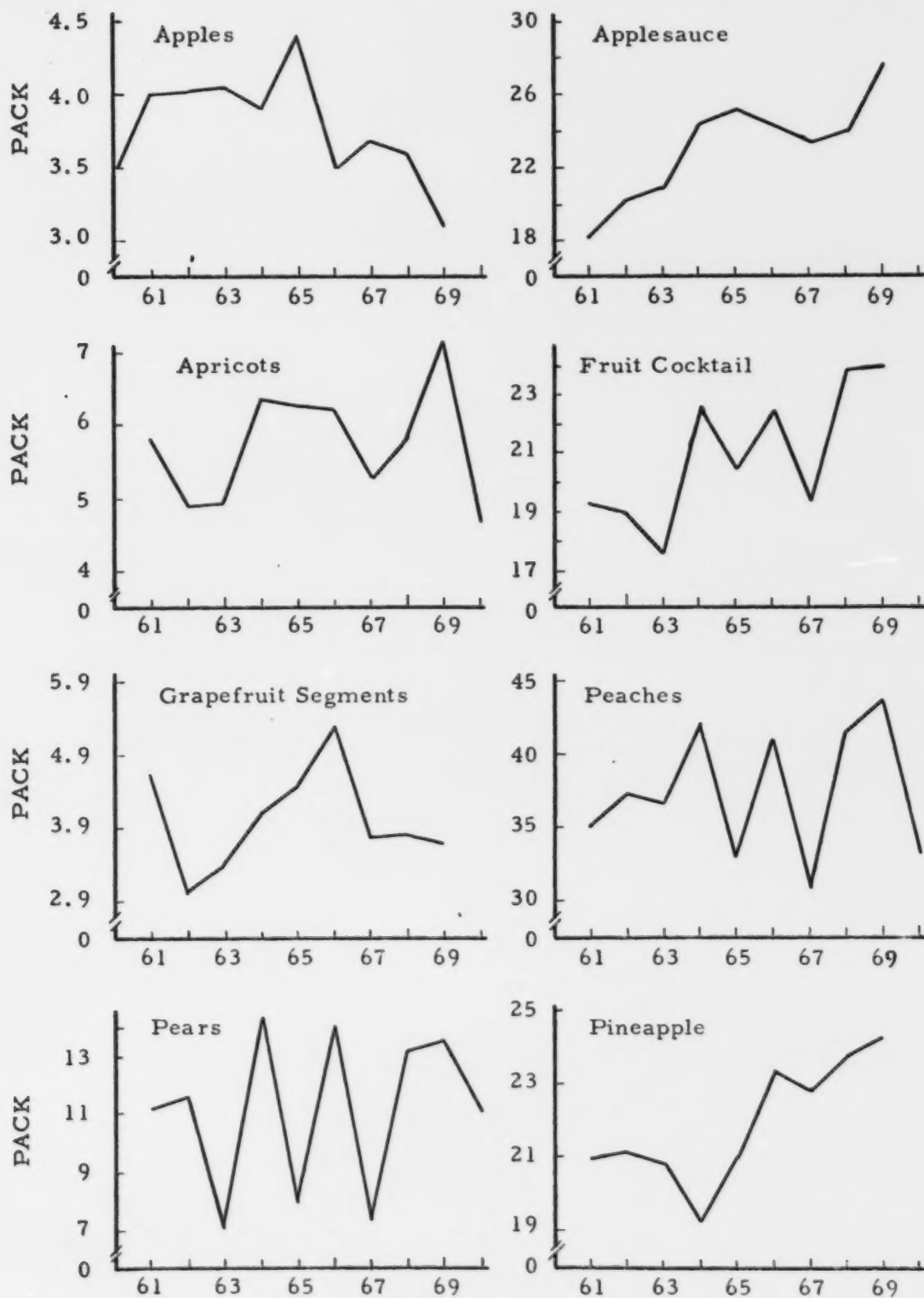


Exhibit II-6. Trends in Volume Packed, Canned Fruits, Millions Actual Cases.

Source: National Canners Association

Apple sauce	-	trend sharply upward
Pineapple	-	trend sharply upward
Fruit cocktail	-	trend moderately upward
Apricots	-	trend slightly upward
Peaches	-	trend slightly upward
Pears	-	trend about constant
Grapefruit segments	-	trend about constant
Apples	-	trend moderately downward

Canned Fruit Juices - Exhibit II-7 shows the ten-year trends for these products to be approximately as follows:

Apple juice	-	trend sharply upward
Grapefruit juice	-	trend sharply upward
Orange juice	-	trend about constant
Pineapple juice	-	trend about constant

Frozen Vegetables and Fruits - In general, there has been a continuing upward trend for frozen vegetables during the past ten years. The same has been true for frozen orange concentrate. However, there has been less growth in the demand for frozen fruit products. Exhibit II-8 shows the trend for major frozen products as follows:

Potato products	-	trend sharply upward
Concentrated orange juice	-	trend moderately upward
Broccoli	-	trend moderately upward
Corn, cut	-	trend moderately upward
Beans, green and wax	-	trend moderately upward
Peas	-	trend about constant
Beans, lima, baby	-	trend slightly downward
Strawberries	-	trend slightly downward

2. Price Trends

Prices of canned fruit and vegetable products vary from year-to-year in relation to two major industry-associated factors: current year pack and year-end carryover stocks from the previous year's pack. In addition, prices are also subject to exogenous economic pressures concerned with production and processing costs and incomes-purchasing power of consumers.

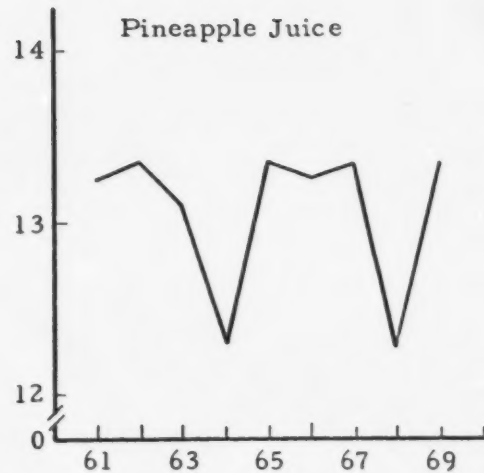
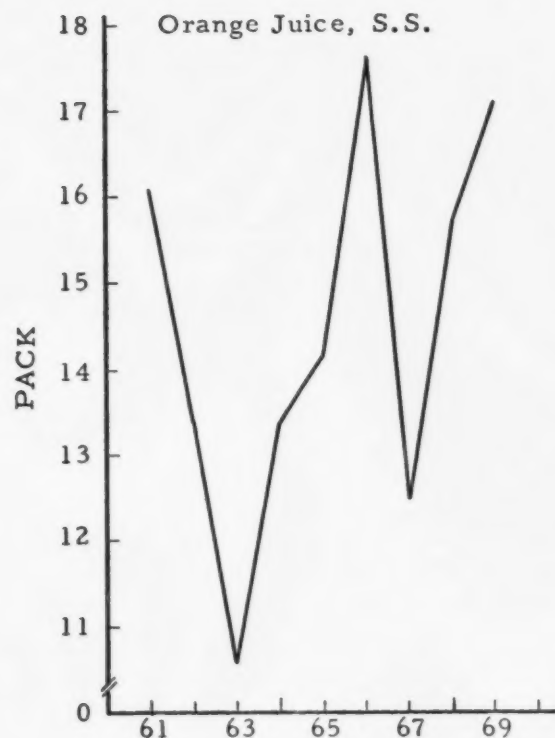
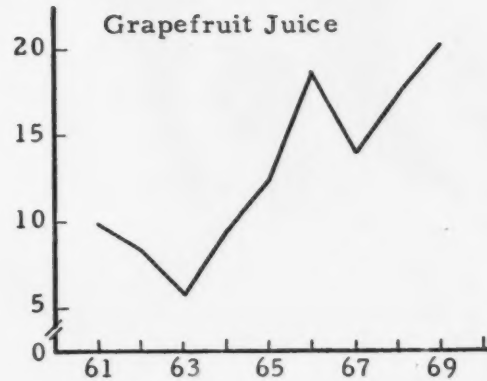
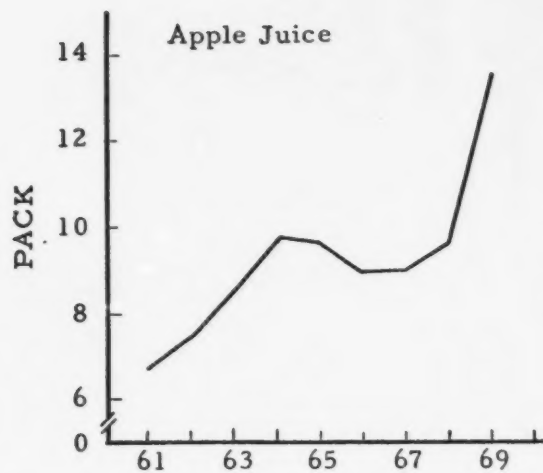


Exhibit II-7. Trends in Volume Packed, Canned Fruit Juices,
Millions Actual Cases.

Source: National Cannery Association

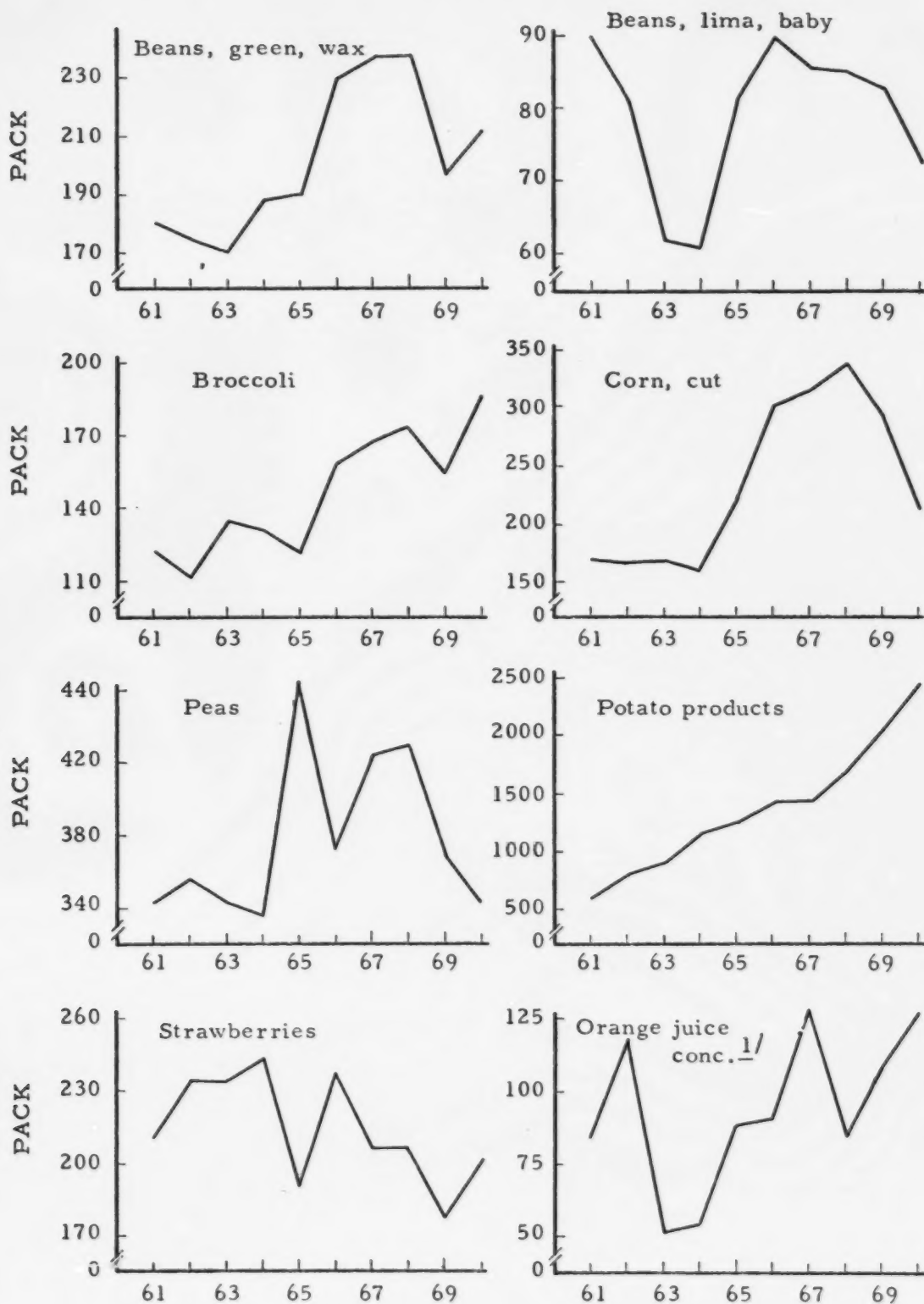


Exhibit II-8. Trends in Volume Packed, Frozen Vegetables, Fruits and Juices, Million Pounds.

1/ Million gallons.

Source: American Frozen Food Institute

Prices for major canned vegetables and fruits were analyzed for the period 1966-1970. Although there is sharp year-to-year fluctuation in prices, identifiable trends appear for most products.

Canned Vegetable Prices - Prices, f.o.b. factory, 1966-1970 for 10 major canned vegetables are shown in Exhibit II-9. Trends observed are as follows:

Asparagus	-	trend sharply upward
Snap beans	-	trend sharply upward
Sweet potatoes	-	trend sharply upward
Peas	-	trend moderately upward
Tomato catsup	-	trend slightly upward
Beets	-	trend slightly upward
Tomatoes	-	trend about constant
Sauerkraut	-	trend about constant
Corn, sweet	-	trend moderately downward
Beans, lima	-	trend moderately downward

Canned Fruit and Juices Prices - A similar analysis for f.o.b. factory prices of canned fruits and juices, Exhibit II-10, showed the following price trends:

Grapefruit segments	-	trend sharply upward
Grapefruit juice	-	trend sharply upward
Pineapple juice	-	trend moderately upward
Orange juice	-	trend slightly upward
Apple sauce	-	trend about constant
Fruit cocktail	-	trend about constant
Peaches	-	trend about constant
Pears	-	trend about constant
Tomato juice	-	trend moderately downward
Cherries	-	trend sharply downward

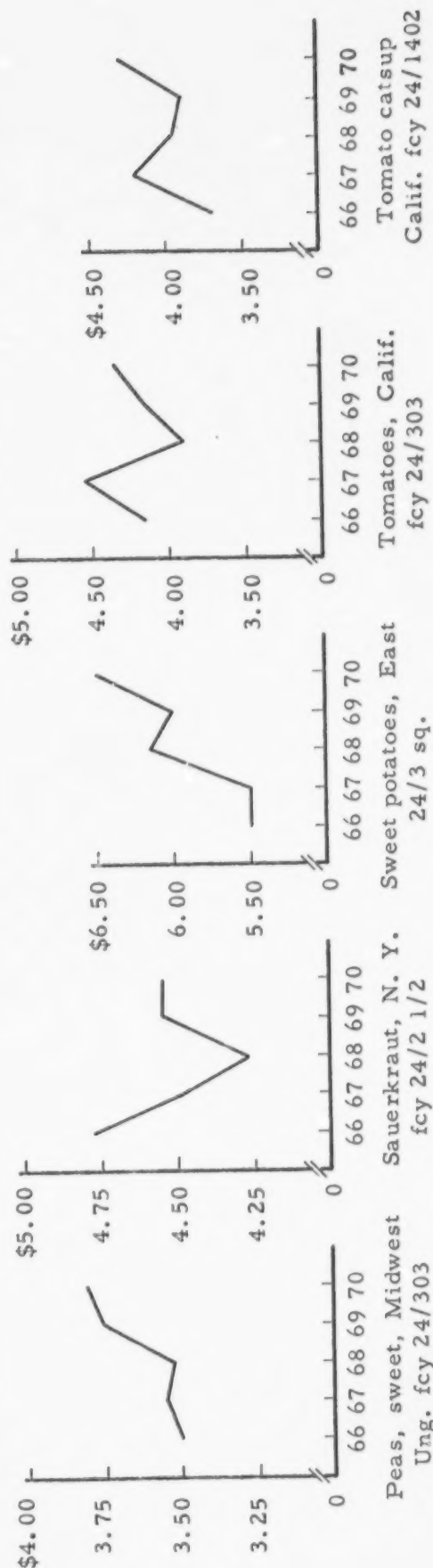
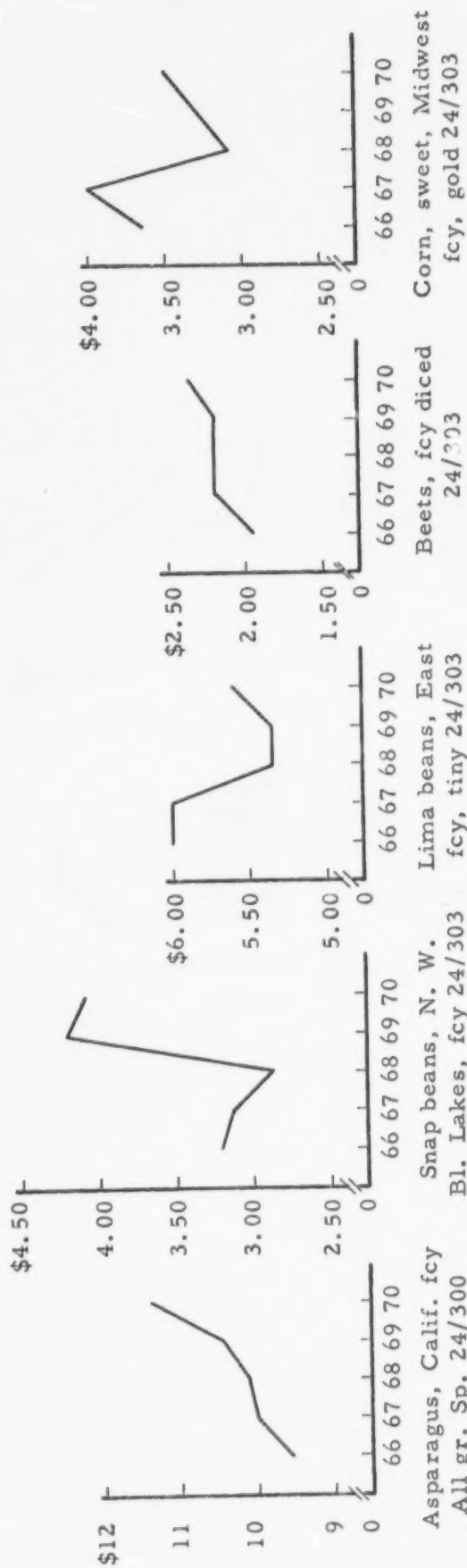
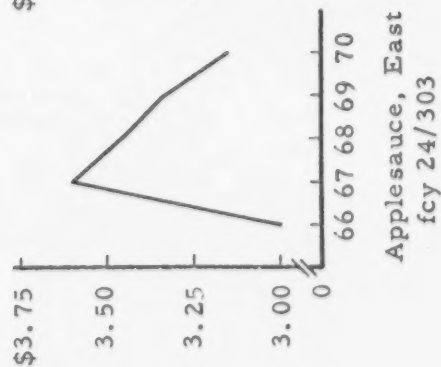
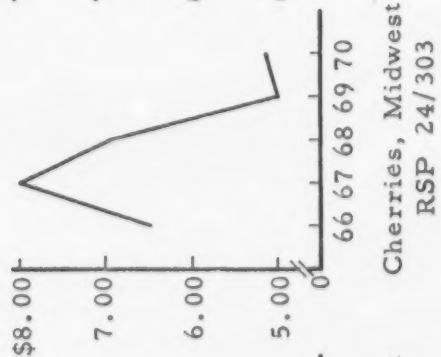


Exhibit II-9. Price, f.o.b. Factory, Canned Vegetables, Dollars Per Case, 1966-67 - 1970-71. ^{1/}

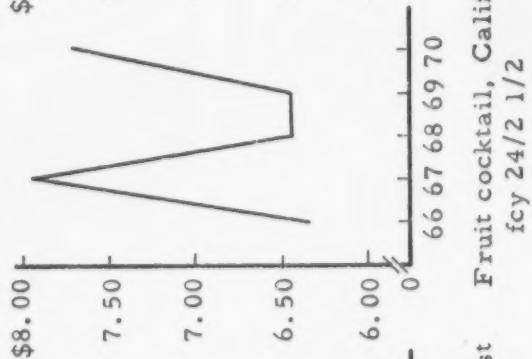
^{1/} Source: Biweekly issues "The Canning Trade"



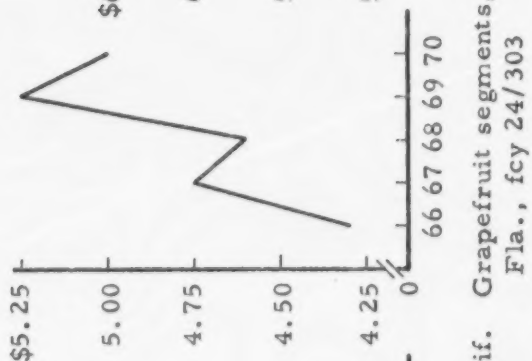
Applesauce, East
fcy 24/303



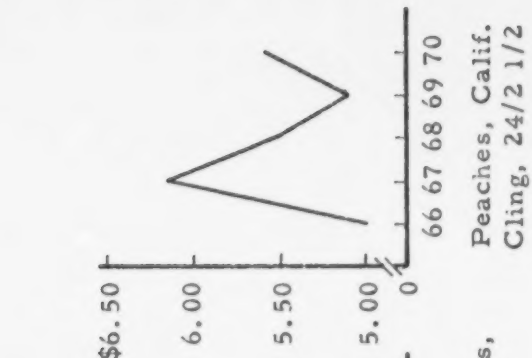
Cherries, Midwest
RSP 24/303



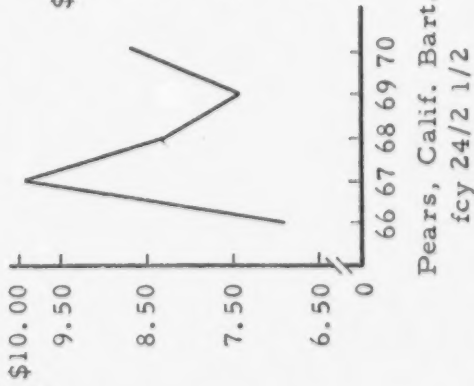
Fruit cocktail, Calif.
fcy 24/2 1/2



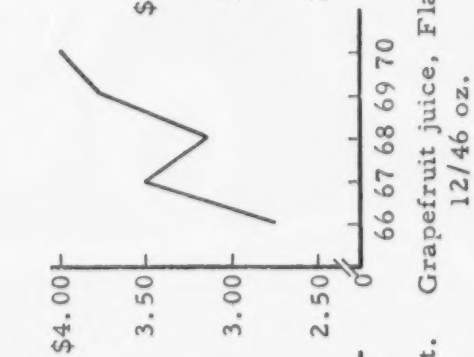
Grapefruit segments,
Fla., fcy 24/303



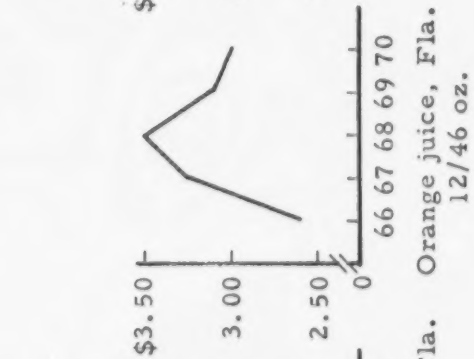
Peaches, Calif.
Cling, 24/2 1/2



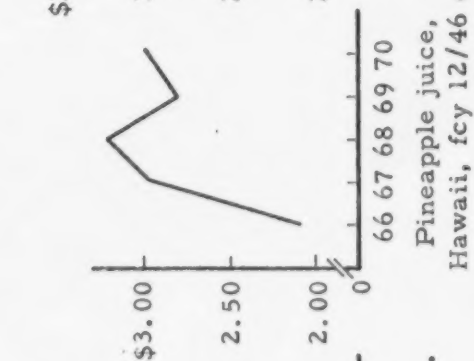
Pears, Calif. Bart.
fcy 24/2 1/2



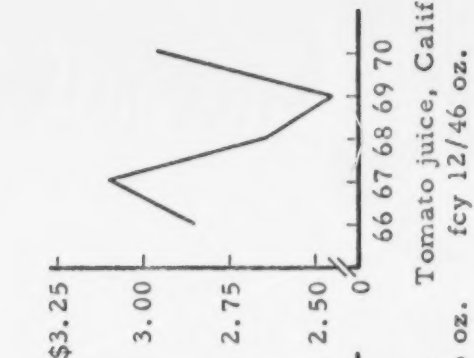
Grapefruit juice, Fla.
12/46 oz.



Orange juice, Fla.
12/46 oz.



Pineapple juice,
Hawaii, fcy 12/46 oz.



Tomato juice, Calif.
fcy 12/46 oz.

Exhibit II-10. Prices, f.o.b. Factory, Canned Fruits and Juices, Dollars Per Case, 1966-67 - 1970-71.^{1/}

^{1/} Source: Biweekly issues: "The Canning Trade"

D. Distribution Systems

Distribution systems for canned and frozen fruits, vegetables and juices are essentially identical in their general organization. Exhibits II-11 and II-12 show the product flow for these products from producer to ultimate consumer.

1. Types of Buyers

In general, three major types of buyers purchase the output of canning and freezing plants. The relative importance of these buyers in terms of their purchases of canned and frozen fruits and vegetables is shown by the following data.

<u>Group</u>	<u>Percent of total output purchased</u> ^{1/}	
	<u>Canned products</u>	<u>Frozen products</u>
	(%)	(%)
Food retailers	49	30
National chains	25	20
Regional chains	12	6
Local chains	9	4
Independent retailers	3	-
Wholesale or co-op buying groups	35	27
Institution and further processors	16	43

Canned products - National retail food chains are the most important type of buyers for canned fruit and vegetable products (25%). Regional, local and independent chains together took 24 percent, wholesalers and cooperative buying groups 35 percent and institutions and government purchases accounted for 11.3 percent. Food processors (4.7) were relatively unimportant as a market for canned and frozen fruits and vegetables.

Frozen products - In contrast to canned products, food processors (28%) were the most important single market for frozen fruits and vegetables. These processors are important in the preparation of frozen dinners, frozen fruit pies, etc. which use frozen fruits and vegetables. Next in importance was national chains (20%) and regional and local chains purchased 10 percent. Independent retailers were a negligible market for frozen products. Wholesalers and cooperative buying groups took 27 percent and institutions and governmental purchasers 15 percent.

^{1/} Source: U.S. Department of Agriculture, Economic Research, Canner Survey, 1965.

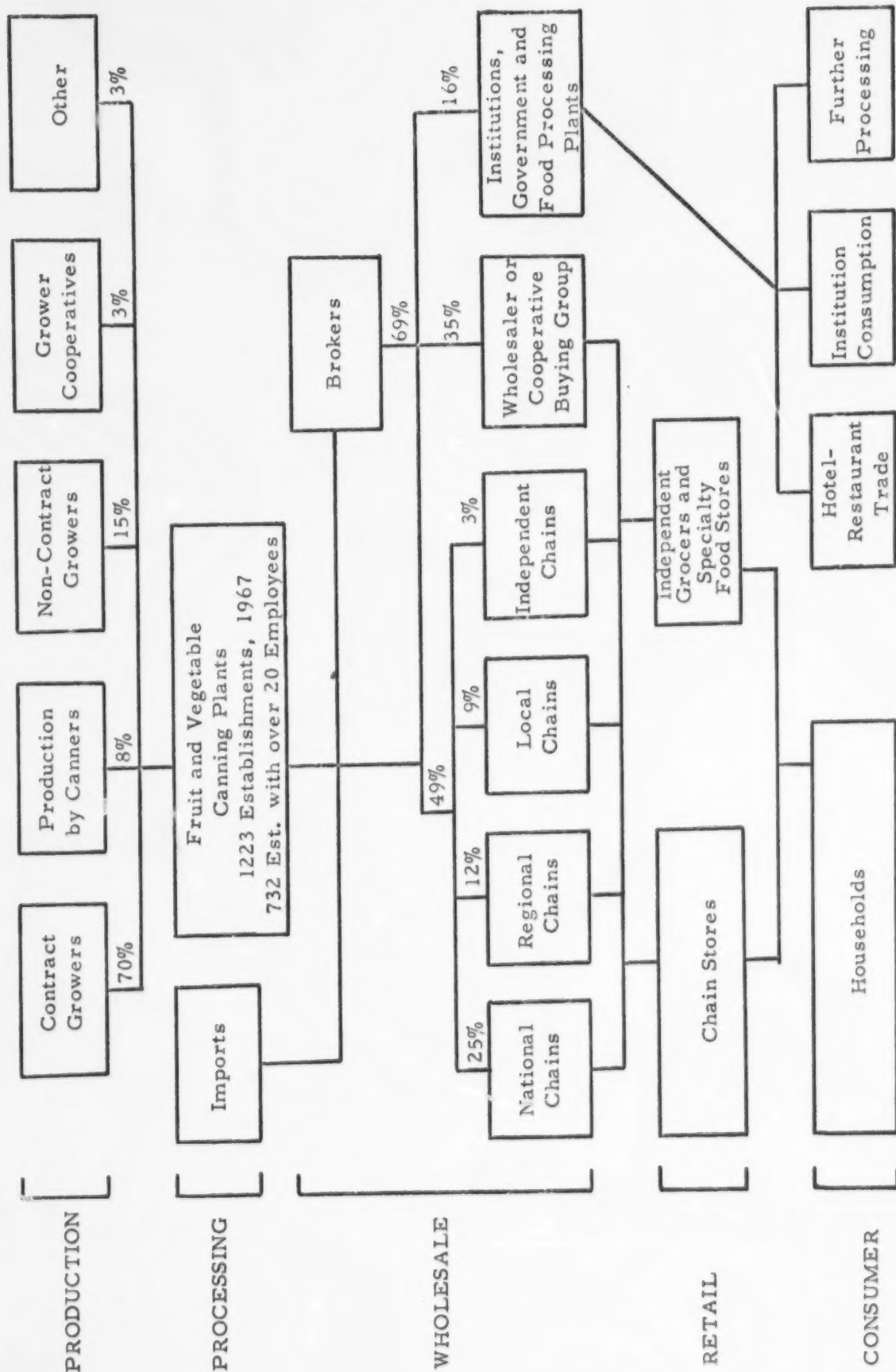


Exhibit II-11. Product Flow of Canned Fruits and Vegetables in the United States.

Source: National Commission of Food Marketing.

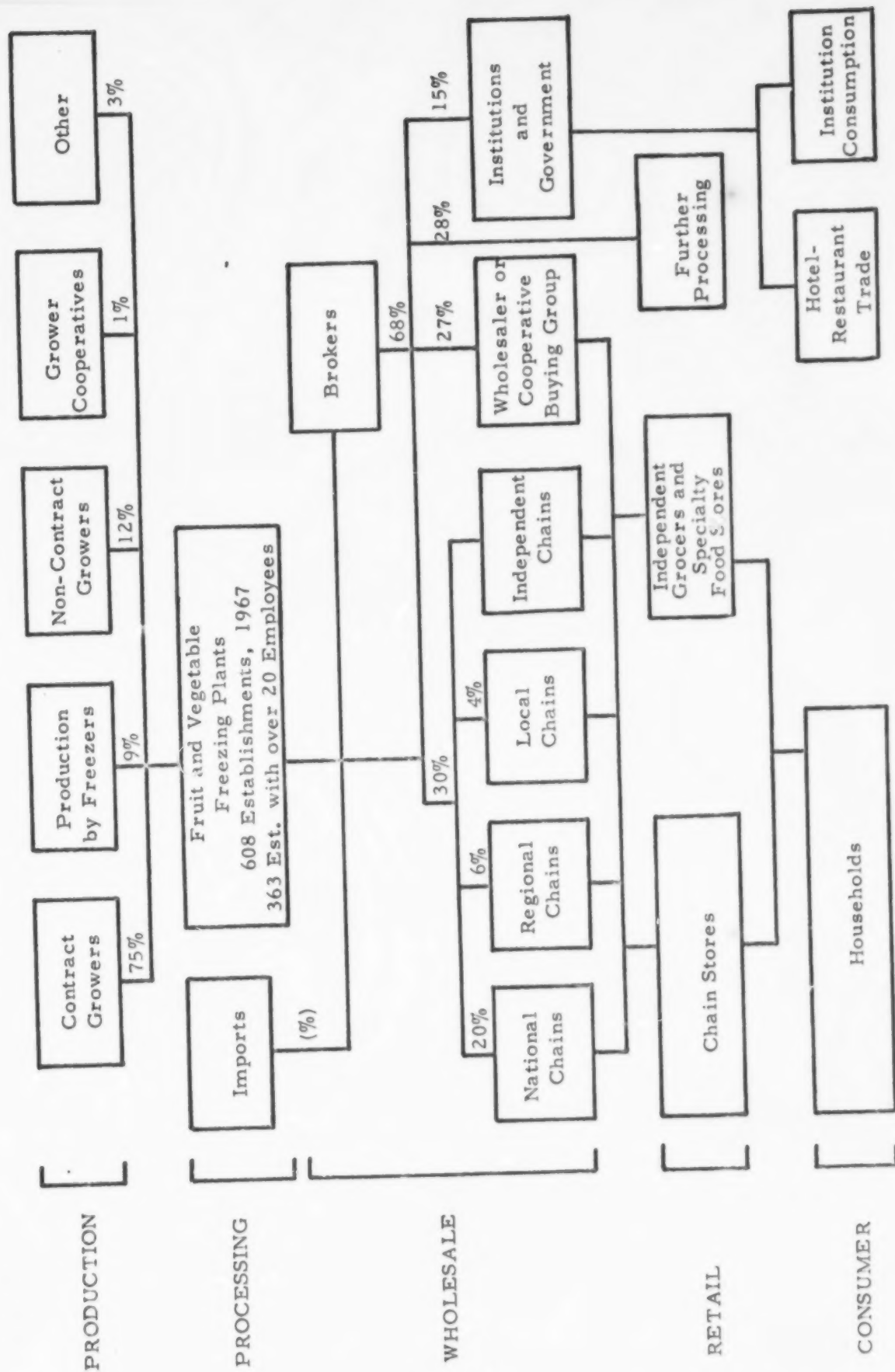


Exhibit II-12. Product Flow of Frozen Fruits and Vegetables in the United States.

Source: National Commission of Food Marketing.

2. Broker vs. Direct Sales

Brokers are an important factor in the marketing of canned and frozen fruit and vegetable products. The broker is an independent sales agent for the processor who neither takes title to or physical possession of the products he sells on behalf of his client. Brokers sold 69 percent of the pack of canned fruits and vegetables in 1964^{1/} and 68 percent of the frozen pack of these products.

Brokers were more important to small and medium canning plants, but small freezers sold a smaller proportion of their pack through brokers than did medium and large freezers. Normal brokerage charges are approximately three percent.

E. Market Competition

Although the fruit and vegetable canning and freezing industries are characterized by the existence of large, multi-product, multi-plant firms, where a relatively small number of firms process a high proportion of the total output, the industry is nevertheless highly competitive. There are a large number of small canners and freezers and the industry is faced with the necessity of selling a high proportion of its total pack to large national food chains. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions.

Market information on current packs, carryover stocks and current prices is readily available so that all segments of the industry operate from a position of reasonable knowledge of market conditions.

Products are relatively standardized and are bought and sold by grade. Once a canning season is underway and prices have found the level dictated, in part, by supply conditions and known pack and stocks, prices are relatively stable as compared to many other industries.

An increasing proportion of the total pack is being sold under private label where packers must meet buyer specifications and compete on a bid-price basis.

^{1/} U. S. Department of Agriculture, Economic Research Service, Canner Survey, 1965.

Competition tends to be centered around national brands, quality and merchandising services more than on price in a given year. Non-price competition includes credit or cash discounts, merchandising services and promotional allowances, but even these forms of competition tend to be standardized.

Strong national trade associations in both the canning and freezing industries serve both large and small packers and provide market information and services to their members.

In summary, the fruit and vegetable canning and freezing industries operate within a stable but competitive industry climate. Prices are determined by pack, stocks and national economic conditions rather than by oligopolistic price management at one extreme or by cut-throat competition at the other.

F. Governmental Influences on the Market

Government -- federal, state or local -- does not usually take a direct role in influencing the marketing of canned or frozen fruits or vegetables.

However, the government is involved in the industry in a number of fields, including but not limited to the following:

- Environmental controls
- Product and plant inspection
- Labeling requirements
- Product grades and standards
- Package and container standards
- Regulation of trade practices
- Warehouse inspection
- Transportation regulation
- Market news and production reports
- Federal and state market orders
- Commodity commissions
- International trade regulation

Of all these governmental activities, the last three -- market orders, commodity commissions and international trade regulations -- relate most directly to the marketing of processed fruits and vegetables.

Marketing Orders may be either federal or state and are based on legislation dating back to the Agricultural Marketing Agreement Act of 1937 plus similar State Acts. There are 90 marketing orders in effect in which producers, handlers and, to a limited extent, processors of fruits and vegetables participate in 23 states.

Marketing orders are intended primarily for the benefit of producers and authorize producers together with handlers (including in some cases processors) to collectively regulate the marketing of a commodity and to engage in research, promotion and other specified activities designed to enhance the market position of the specified commodity.

The major marketing orders which involve processors are California State Orders which operate in the following industries:

Cling peaches
Bartlett pears
Hardy pears
Olives
Strawberries
Brussels sprouts - freezing only

Only two of these orders, cling peaches and Brussels sprouts, permit volume regulation.

The Brussels sprouts order is chiefly concerned with authorization of entry of new producers.

The cling peach order is almost unique in that it regulates supply in advance of the processing season by a green drop program which removes fruit from the growing crop.

Other marketing order activities involve:

- * grade, size, maturity or quality regulation
- * unfair trade practices regulation
- * inspection and certification
- * promotion and advertising
- * research

With the exception of the California orders mentioned above, marketing orders do not constitute an important factor directly influencing the fruit and vegetable processing industries.

Commodity Commissions are usually State Commissions concerned with market development for specific commodities. Examples include the Florida Citrus Commission, Maine Potato Commission, Washington State Apple Commission, Michigan Cherry Commission, etc.

Most Commission activities are directed toward advertising and promotion, research and product development. Some work also overseas and may be financed in these activities by PL 480 funds derived from overseas sales of surplus U. S. agricultural products.

Some Commissions, such as the Florida Citrus Commission, have extensive advertising and research programs and work closely with processors in market development efforts.

International trade regulation is a normal activity of the federal government and involves the development of U. S. tariffs and import quotas, the negotiation of international tariff and trade agreements and the development of international standards for product quality and trading practices.

Except for a limited number of products (e.g., mushrooms) which are imported in substantial quantities (see page II-23 of this report), international trade regulation is not a high priority problem for the U. S. canning and freezing industry.

The United States is working with other nations through FAO/WHO toward the establishment of a Codex Alimentarius which would set international standards for food products and would facilitate international trade in these products.

In summary, the principal governmental influences relating to the fruit and vegetable industries are concerned with product and container standards, plant and product inspection and labeling requirements. There is little direct governmental influence which affects the marketing of these products.

III. SUPPLY CHARACTERISTICS OF THE FRUIT AND VEGETABLE INDUSTRY

The fruit and vegetable canning and freezing industries are supply-oriented in that the location of processing plants is dictated by the location of raw product production. Most fruits and vegetables are perishable or semi-perishable and for most products, the time-lag between harvesting and processing must be kept to a minimum to maintain high standards of product quality.

The diversity of products processed and the seasonal production requirements of basic fruit and vegetable crops, results in a widespread network of canning and freezing plants. Specific fruit or vegetable crops may be produced in more than one area at different seasons of the year.

Although a relatively small number of firms produces a relatively large percentage of the total pack, the production of these large, diversified packers is obtained from a large number of plants scattered throughout the principal producing areas. Although there is appreciable concentration of capacity in a few firms, there is widespread geographic dispersion of processing plants.

Partly as the result of shifts in the relative importance of raw product production areas, there is some lack of balance in capacity and utilization of capacity of processing facilities.

The industry has a high capacity to utilize large numbers of relatively low-skilled production workers, especially women, but at the same time demands a cadre of highly skilled technical, quality-control and managerial staff.

Production technology has changed substantially in recent years and plant obsolescence is an important factor, especially among small independent packers. There are appreciable economies of scale in production and as a result there is a continuing decrease in the number of operating plants.

A. Industry Processes

Basic industry processes have been adequately described in the Federal Water Pollution Control Administration report "The Cost of Clean Water." ^{1/} The following material is extracted from this report and is reproduced here to make this report complete in itself.

Canned Fruits and Vegetables

Due to the diverse nature of the products handled by this industry, a multitude of process schemes could be described. Each cannery is probably unique in its inhouse process. However, for the purposes of this report, processes will be generalized into the following categories:

1. Preliminary Cleaning and Preparation
2. Canning of Fruits and Vegetables
3. Canning of Juices

Meat and fish processing are not included in this study, nor are the canning of specialty items, jams and jellies, or pickles.

Wherever possible, important subprocesses associated with specific fruits and vegetables will be described in detail.

Preliminary Cleaning and Preparation

Raw products intended for commercial canning must be cleaned. The procedures of cleaning vary with the nature of the food; but all raw foods must be freed of adhering soil, dried juices, insects, and chemical residues. This is accomplished by subjecting the raw foods to water baths and high-pressure water sprays while being conveyed on moving belts or passed through revolving screens. Product wash waters may be fresh or reclaimed from an in-plant operation, but should be of suitable quality. The wasted wash waters contain, in soluble and suspended form, the contaminants removed from the raw product, and juices and fragments of the product being washed.

^{1/} Federal Water Pollution Control Administration, U. S. Department of Interior, "The Cost of Clean Water," Volume III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, Sept. 1967.

Important factors affecting the preliminary cleaning process are the method of harvesting, whether field washing is practiced, and the care taken to protect the raw product from damage during transportation from field to cannery. The increasing use of harvesting machines has caused a dirtier raw product containing more debris, leaves, vines, damaged produce, etc. than did the older, hand picking methods. Preliminary washing of the raw product in the field greatly reduces the pollution generated by the cannery, but unfortunately this is not a prevalent practice.

Pre-cleaning and inspection: These processes use both "wet" and "dry" methods and also mechanical and hand operations. Agitating by hand, screens, jets of air, and belt and roller systems are examples of "dry" systems; while water (wash) spraying, flotation, soaking, and fluming are "wet" methods.

Tomatoes, for example, are either discharged or dumped directly by hand or mechanical means from the hampers or lug boxes into the soak washer. The purpose of this operation is to loosen much of the adhering soil and other contamination thereby reducing the load on the spray washer. The product moves through the soak tank emerging on a belt after 1 - 3 min (or more), and is washed by overhead spray. This soak/wash operation gives large volumes of waste. Of the 4000 gal/raw ton tomatoes, 880 gal or 22 percent are used for removing the soils and any other foreign matter on the product before further processing. Total suspended solids may range from 180 to 1584 ppm. Grapefruit, on the other hand, is spray washed with 2200 gph compared with a total water use of 22,600 gph; i.e., less than 10 percent of the water is used for washing.

Shelled peas are first cleaned. Three shaker screens are used in the cleaner to remove pieces of pod and vine, fine dirt, and splits. An air blast through which the peas fall takes out light extraneous material. The peas are then put through a flotation washer where the cold water washes away the vine juices and field dirt. Any skins, splits, or other lightweight foreign material is removed by flotation, while any sand or small stones and silt sink and are caught by riffles. The peas then pass through a reel equipped with a fresh water spray where the peas are separated from the wash water. Total suspended solids in the wash water range from 270 to 400 ppm.

In addition to the cold water flotation washer, many canners are now using a froth flotation cleaner. This cleaner operated on a principal of difference in wettability between product and the extraneous material. It has been found to be very efficient in removing nightshade berries, thistle buds, weed seeds,

etc. which are less easily wet than peas so that they float out in the froth emulsion while the product such as peas sink.

Sorting operations may select for size, maturity, weight, quality, and/or other characteristics. With some food products (such as peas) there is no sharp line between the sorting and preliminary cleaning. Hand sorting at a "sorting table" remains the method of choice and often combines cleaning and some preliminary preparation.

The husking of corn by machine serves to clean, prepare for processing, sort, and grade in one operation. The "sorting table" may feature several belts or bins or chutes by which the product is handled. Tomatoes use a variation of this method, including the cutting and trimming of spoiled portions.

Trimming, Coring, Pitting and Cutting: These operations usually involve both mechanical and hand processing. Trimming is usually a hand operation and frequently takes place at the sorting table or nearby. Product portions are removed for size, weight, quality, or processing needs.

Pears, apples, peaches, olives, cherries and apricots are usually cored or pitted before processing. Coring and cutting of pears and apples is a mechanical process. Peaches and apricots are cut into halves by machinery as the pit is removed. Following the halving and pitting operation, the fruit halves are inspected by hand. Halves from which the pits have not been completely removed are segregated for re-pitting.

Peeling: Peeling or skin removal of the product is also an incidental form of cleaning. It can be accomplished by hand, machine, or chemicals.

Mechanical or chemical peeling may be performed for apples, pears, potatoes and other products. Some fruits such as potatoes, beets, turnips, and carrots may be peeled in a cylinder whose walls are abrasive in nature. The drum is rotated and water is introduced.

Formerly, soft fruits and vegetables, such as tomatoes, were first scalded by steam or hot water and then peeled by hand. In most modern plants, tomatoes, peaches, and other fruits are usually peeled by immersion in a hot lye solution, or they may pass under a spray or cascade of the same solution. For example, most clingstone peaches on the Pacific Coast are lyepeeled. The peaches are dumped or conveyed on an inclined conveyor belt into a lye peeler where the halves are positioned cup side down and exposed to a heavy flow of 1 1/2 to 5 percent lye solution at a temperature of about 210°F for 45 to 60 seconds. The lye solution is recirculated to

conserve caustic, lessening the amount of lyewaste. Many canners use wetting agents to facilitate the removal of skins. The wetting agent is added directly to the lye solution. Although the effectiveness of a wetting agent has been somewhat controversial, it has been claimed that its use materially reduces the amount of lye normally used. The first rinse water of the skinned product is usually segregated to produce an effluent with a high wasteload.

A major use of water is the rinse of chemically peeled fruits and vegetables to remove excess peel and caustic residue. Water of suitable quality is used for final rinse. This is reused in the initial wash. The spent peeling solutions are strong wastes, high in organic and inorganic content. Following removal of the peel, the fruit halves are size graded on a shaker grader and then each size is inspected on an inspection belt for off-color and imperfect fruit. These imperfect units, which are unsuitable for halves or slices, are usually diverted to pie stock or fruit cocktail.

Product Preparation: This step is the final preparation of the food material prior to transportation to specific secondary operations such as canning, juicing, etc. It consists of several independent operations. Some of the more complex operations require considerable time, labor, and material. Post-sorting, by hand or machine; specialized cutting such as dicing carrots and potatoes; "finger slicing"; size grading; blending; and final inspection are included in this category.

Transportation: Washed raw products are transported to and from the various operations by means of belts, flumes, and pumping systems. This is a major use of water. Although the fresh water make-up must be of suitable quality, recirculation is practiced to reduce water intake. Chlorination is used to maintain certain recycled waters in sanitary condition. Waste waters from the hydraulic systems contain product materials in soluble and suspended forms.

Summary: These preliminary operations, including plant cleanup, can use up to 50 percent or more of the total water used in the canning industry, and they contribute the major portion of solid wastes (screenings) associated with the overall process.

Canning of Fruits and Vegetables

The processes described herein are not necessarily meant to operate in series or in the order indicated. Table III-1 summarizes the major steps in canning and freezing fruits and vegetables.

Table III-1. Summary of Major Steps in Canning and Freezing
Fruits and Vegetables

Stage of Process	A. Canned Fruits & Vegetables	B. Frozen Fruits & Vegetables	C. Canned & Frozen Fruit Juices
I. INITIAL PREPARATION			
A. Raw Product Cleaning		1. Precleaning 2. Sorting	
B. Raw Product Preparation		3. Trimming 4. Coring & Pitting 5. Cutting 6. Peeling 7. Grading & Final Inspection 8. Transport	
II. CONVERTED PRODUCT HANDLING			
	9A. Blanching	9B. Blanching	9C. Extraction
	10A. Mixing & Adding	10B. Cool	10C. Screening
	11A. Pulping	11B. Wash	11C. Deoil
	12A. Straining	12B. Final Preparation	12C. Deaerate
	13A. Cooking in vat	13B. Pack	13C. Clarify
	14A. Can Filling	14B. Freeze	14C. Pasteurize
	15A. Can Ex- haust	15B. Cold storage	15C(1) Canned Pack (Incl. Addi- tives, Syrup)
	16A. Seal & Thermo Process	16B. Plant Cleaning	15C(2) Frozen Pack (Incl. additi- ves & Con- centration)
	17A. Can Cooling		16C(1) Storage
	18A. Storage- Room Temp.		16C(2) Freeze
	19A. Plant Clean-up		17C(2) Storage 18C Plant Clean- up

Blanching: Blanching operations are designed to expose the entire product (most green vegetables) to high temperatures for a short period of time. The primary function of this operation is to inactivate or retard bacterial and enzyme action which causes rapid degeneration of quality. Although high sugar content in green peas is a desirable quality, it makes them quite sensitive to sugar-substrate enzymes. Other carbohydrases and proteinases create similar problems.

Secondary desirable effects of blanching include the expelling of air and gases in the product, as well as the reduction of volume of the product. Leaching of sugars, starches, and other soluble organic compounds from the raw fruits or vegetables into the blanch water makes it a very strong liquid waste when discharged.

Depending upon the product and/or availability of equipment, blanching may be accomplished by immersion in hot water (180°-212°F), or exposure to live steam.

Pulping and Straining: These operations are usually carried out prior to cooking or, as in the baby food industry, after heating and/or cooking.

Cooking: Cooking and other types of heating are applied to several types of foods. Tomato sauce, paste and catsup all require heating (or cooking) with some salt, spice, or acid not included in the usual processing flow.

Mixing and Adding: Other constituents are mixed with and added to the main product. These additives are spices, thickening agents, syrups, juices, water, salt, brine, etc. which will enhance the product during heating operations.

Inspection and Packing: Final inspection operations involve several sub-component operations depending upon the product. Quantity as well as quality control procedures will cover product examination, including batch quality/quantity control; rejection re-routing; container portion control; total additives prior to filling and sealing; weight control before and after container packing; case packing control; and processing load.

Batch volume for container packing will usually determine final additive characteristics and desired concentration. The addition to the product may be made either in the batch container or in the container itself during packing/filling operations.

Metal cans, glass containers, 55 gal steel drums suitably lined, and plastic-lined fiber-backed drums are used as containers. These are commonly washed prior to use producing a waste water suitable for reuse elsewhere in the plant.

After filling it is desirable to pass the sealed cans through a hot water spray washer following closure to remove any adhering product. It is important that the retorts or continuous cookers are clean to avoid unnecessary cleaning of the cans after processing.

Thermo-process: Thermo-processing is the process in which the sealed cans are exposed to high temperature for varying lengths of time depending upon the nature of the product. The purpose of the thermo-process is to render the product commercially sterile by killing all bacterial spores which could spoil the product or cause illness to the consumer. Once the containers are filled, inspected, sealed, thermo-processed, cooled, dried and labeled, they are cased and ready for shipping.

Canning of Juices

Following initial preparation, the first step in the canning of juices is extraction. There are several methods, including the following for citrus juices:

- Rotary juice extraction - halved oranges are held in depressions in rolls while they are pressed by protuberances within lower rolls.
- FMC Inline extraction - oranges are pressed between upper or lower intermeshing multifingered extraction cups.
- The Buron Machine - halved fruit is reamed automatically.
- Citro-Mat extraction - halved fruit is pressed between rotating rolls, one of which rotates twice as fast as the other.

Extraction of tomato juice may be accomplished by several different types of commercially available extractors. These include either the screw type or paddle type extractors. Screw type extractors press tomatoes between a screw and screen. The perforations in the screen vary but usually are about 0.02 to 0.03 inches in diameter. Some installations are equipped with a shaker screen ahead of the extractor where scald spots along with stems, cores, and other foreign material can be removed.

For all juices, the extraction is followed by a screening operation to remove pulp and seeds.

Citrus juices generally require deoiling which employs heating to about 125°F in a heat exchanger maintained under a vacuum of 26 in. The vapors containing the oil are condensed and run to a decanter where the oil separates and is drawn off the top layer. The lower layer is returned to the deoiler. About 80 percent of the oil is removed in this process.

If deoiling is practiced, deaeration usually occurs at the same time. Otherwise, deaeration is a separate operation. The juice is introduced in a thin film or finely divided particles into a vacuum chamber. Steam used in the evacuator is usually vented to the atmosphere; if condensed, this liquid could contain some pollutants.

If the juice is to be concentrated, it must first be pasteurized. The preferred method of pasteurization is the use of heat exchangers, either tubular or plate type. Juice should be heated to 185°-200°F in a few seconds to inactivate enzymes and destroy spoilage organisms, and then immediately concentrated.

The juice is concentrated in vacuum evaporators. In a vacuum concentration, the water is removed by boiling at moderate temperature under appropriate vacuum. Either a series of single effect evaporators or multiple effect evaporators may be used.

During vacuum concentrating, the volatile constituents are largely removed. For some uses, it is desirable to replace some of these constituents. This has been attempted in the past by either condensing the initial distillate and fractionating to recover some of the volatile constituents which are added back to the concentrate, or by adding terpeneless orange oil.

Tomato juice is sometimes homogenized to produce a thicker-bodied product and to prevent settling of the solids. The general practice is to eliminate the homogenization particularly when "hot break" juice is being packed. When homogenizers are employed they are operated between 1000 and 1500 lb per sq in of pressure at a juice temperature of about 150°F.

Frozen Fruits and Vegetables

Due to the diverse nature of products handled by this industry, coupled with the 1150 plants producing a variety of frozen foods, a multitude of process schemes could be described. Each frozen food processing plant is probably unique in its inhouse process. However, for the purposes of this report, processes will be generalized into the following categories:

1. Preliminary Cleaning and Preparation
2. Freezing of Juices
3. Processing of Frozen Fruits
4. Processing of Frozen Vegetables

Meat and fish processing are not included in this study, nor is the freezing of prepared foods and soups.

Preliminary Cleaning and Preparation

The preliminary cleaning and preparation required for raw fruits and vegetables to be frozen is essentially the same as that described for canning. However, these preliminary operations plus plant cleaning can use up to 90 percent of the process water (exclusive of freezing system water) used by the frozen food plant, and they normally contribute the major portion of the pollution associated with the overall process.

Juices - Frozen

In general, the methods employed in the preparation of fruit juices for freezing differ little from those used in the manufacture of fruit juices for flash pasteurization.

The principal exception is that the juice is always concentrated, and most of the water removed from the raw product is discharged to waste. Since the vacuum evaporators are not 100 percent efficient, this waste has a fairly high organic pollution loading.

Freezing of Fruits: In the freezing of fruits and vegetables, the preliminary processes are very similar to those of canning. The wastes produced are also quite similar. The flavor and color of many varieties of fruit can be well preserved by freezing, but a change in texture always occurs. A pronounced characteristic flavor, attractive color, and good texture should be retained after defrosting. Most frequently, it is the texture change which makes a variety unsuitable. Since soil and climate affect fruits' characteristics for freezing, the area of the United States in which it is grown will also affect its suitability.

Quick Freezing Methods for fruits in the United States began about 1929 on a commercial scale. Early methods used immersion of the product in brine, or freezing of one side of the product only. Neither was satisfactory for frozen fruits. In 1929, a Birdseye belt freezer was installed in the Ray-Maling plant at Hillsboro, Oregon. This process eliminated the danger of spoilage due to bacteria, yeasts, and molds during freezing of

fruit and also resulted in a somewhat improved texture. On the other hand, the quick freezing of a fruit packed in syrup or with sugar immediately after packaging did not allow the sugar to penetrate sufficiently into the fruit. For this reason, processors have found it beneficial to hold fruits packed with sugar or syrup at a temperature just above freezing for 1 - 2 hr prior to quick freezing.

Although the untreated fruits in many instances are greatly changed by freezing and thawing, comminuted fruits such as pulped fruit and fruit juices may be preserved by freezing for considerable periods of time without marked change either in flavor or color. Pulping a fruit or converting it into juice greatly reduces the exposure of the product to air, and thus largely eliminates oxidation during freezing, storage, and thawing. A similar effect may be obtained by freezing fruits under plain sugar syrup or under syrup made by dissolving sugar in juice.

Freezing of Vegetables: Until 1928 it was believed that freezing ruined vegetables since accidentally frozen vegetables spoiled almost immediately after thawing, and were unpalatable when cooked. However, in 1929, both Joslyn and Cruess concluded independently that it was necessary to blanch vegetables before freezing. They recommended blanching with steam in preference to hot water. Blanching stops the enzymatic degradation of vegetables which occurs after harvesting because of respiration, reduces total bacteria count, and markedly retards the rate of loss of vitamins A, B₁, and C during storage.

Water blanching is often carried out in boiling water; sometimes water as cool as 180°F is used. Hot sugar and acid solutions have been recommended for blanching certain products but are not commonly used. Steam is ordinarily used at atmospheric pressure. The inactivation of the enzymes catalase and peroxidase is the prime objective in blanching. In general, there is a critical temperature range for each vegetable at which color, flavor, and texture is most benefited by heating. The size of the vegetable is also a factor in determining the temperature and length of time of blanching. For example, corn on the cob requires a longer inactivation period than peas.

The general procedures recommended by Joslyn and Cruess in 1929, before the advent of commercial freezing of vegetables, were still used after 1957. The only difference is that after 1957 the blanched vegetables were packed in cartons without covering with brine as suggested by Joslyn and Cruess. Vegetables are almost invariably prepared for cooking before being frozen to preserve their crispness and valuable juices.

Product

Processes

Broccoli

Steam blanched 3-5 min
Cooled in sprays or by immersion in water
in an endless chain
Packed in cartons
Frozen in air blast freezer on coils or on
plates

Corn (cut)

Steam blanched at atmospheric pressure 2-4 min
Cleaned and cooled by water to remove bits of
silk, husk, tiny particles or corn
Packed
Frozen in multiple freezer or trays placed
on racks

Peas

Conventional hot water (most popular) or steam
(atmospheric blanching for 50-60 sec between
185°F and 205°F)
Some recirculation of hot water is practices
Cooled in water flumes
Washed to remove salt
Packaged

TYPICAL EXAMPLES OF FRUIT FREEZING PROCESSES

Peaches

Anti-oxidant fortified syrup added after
peeling and cooling
Packed in cartons
Held at a temperature just above freezing for
1 or 2 hours to allow syrup to penetrate fruit
Quick frozen

Strawberries

Sugar syrup or dry sugar added
Packed in cartons or bags
Quick frozen

B. Types and Locations of Raw Materials

The fruit and vegetable canning and freezing industries are primarily oriented toward the location of supplies of fruits and vegetables processed. Other materials used, such as sugar, seasonings, cans, cartons, etc. are important but the raw product tonnage required and the perishable nature of fruits and vegetables make the location of raw materials of paramount importance.

1. Vegetables for Processing

Production of vegetables for processing is widely dispersed throughout the United States and commercial production is found in every state. However, production is concentrated in the West, mainly in California and the Pacific Northwest, with the North Central region being the other major producing area. Exhibit III-1 shows the regional distribution of production of vegetables for processing 1957-59 and 1967-69. The western region now produces 51 percent of the total tonnage of vegetables for processing, up six percent from 1957-59. The North Central region accounts for 31 percent, down two percent from a decade earlier. The North Atlantic contributes 10 percent, down three percent, the South Atlantic five percent, down one percent and the South Central region has maintained its share of production of vegetables for processing at three percent.

The leading states in the production of major vegetable crops for processing are shown in Exhibit III-2 and Table III-2. California is the most important single state, producing 38.3 percent of the total tonnage. No other state produces over 10 percent of the total grown. A high degree of concentration is shown in production areas for most vegetable crops, as follows.

Tomatoes	- California 66.5 percent of total
Snap beans	- Oregon, New York and Wisconsin - 58.7 percent
Sweet Corn	- Minnesota plus Wisconsin - 51.4 percent
Green peas	- Wisconsin, Washington, Minnesota - 64.0 percent
Cabbage for kraut	- New York, Wisconsin, Ohio - 76.0 percent
Beets	- New York, Wisconsin - 67.2 percent
Sweet potatoes	- Louisiana, N. Carolina - 58.0 percent
Lima beans	- California, Delaware - 55.0 percent

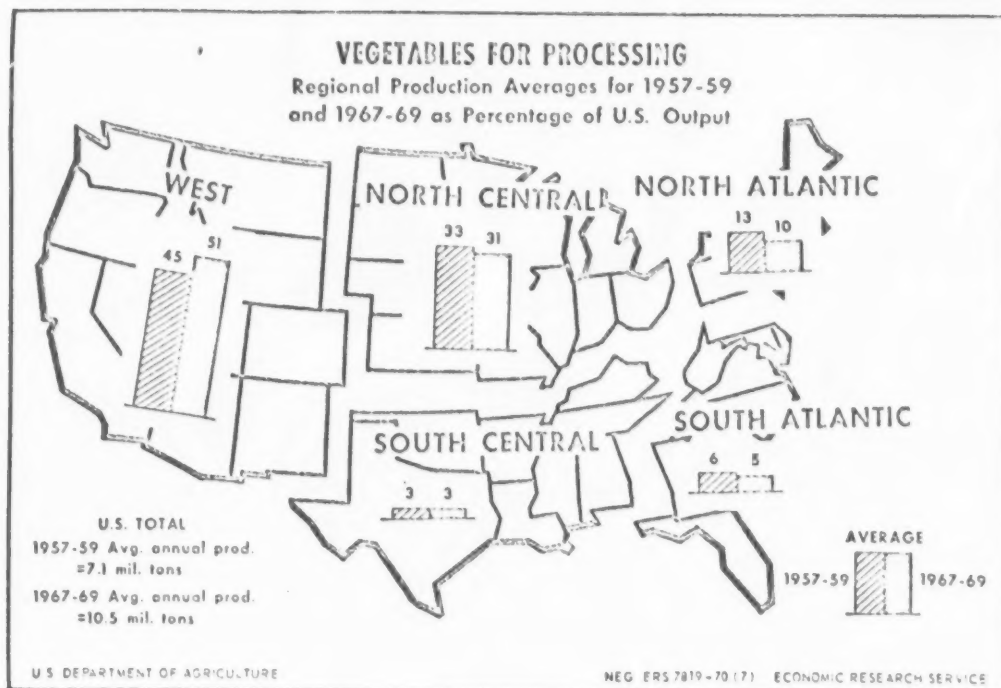


Exhibit III-1. Vegetable production for processing, regional distribution of tonnage, 1957-59 and 1967-69.

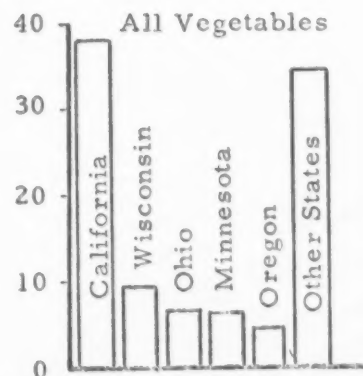
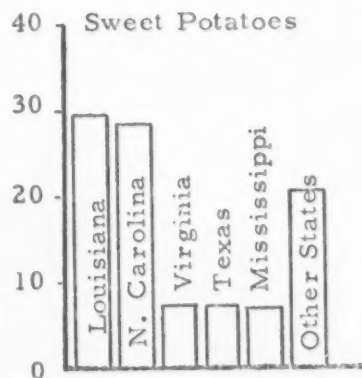
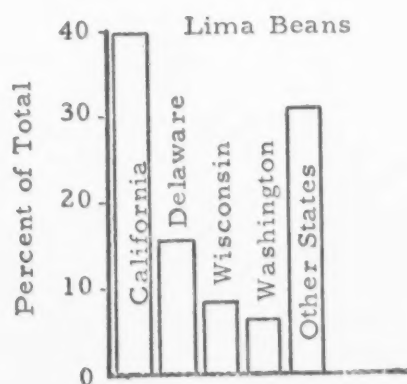
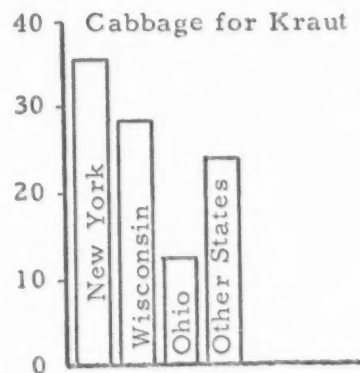
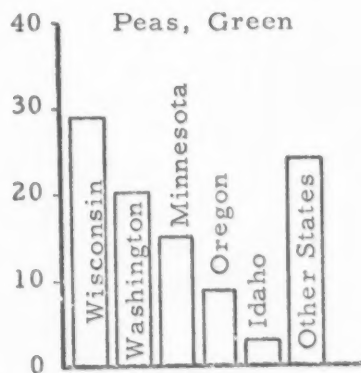
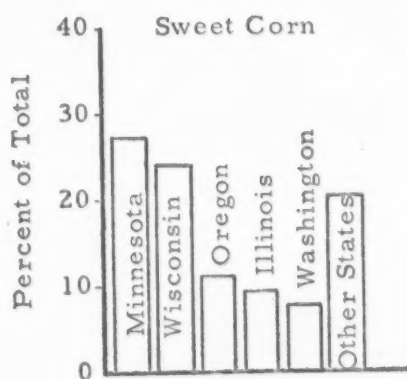
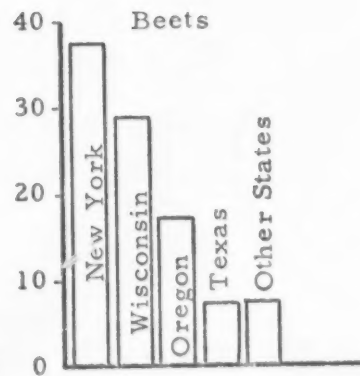
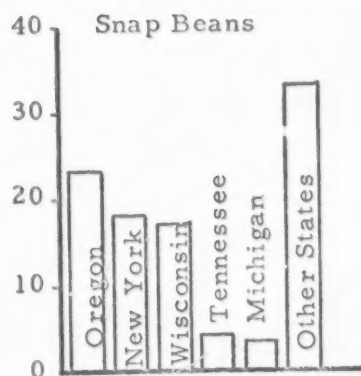
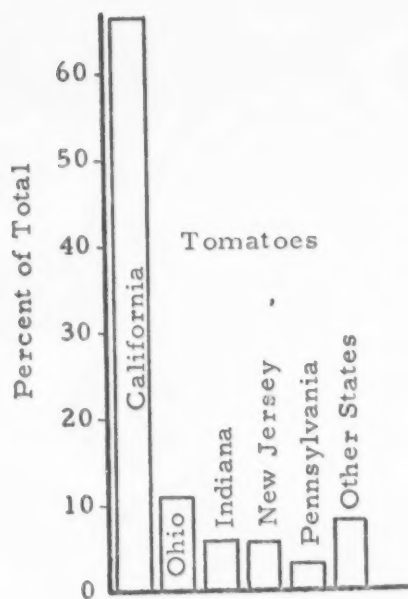


Exhibit III-2. Vegetables for Processing, Leading States, 1970 - Percent of Total Production in Each State.

Table III-2. Vegetables for Processing, Principal Production Areas.
Volume and Percentage of Total Production in Leading States^{1/}

Product	State	Volume	% of Total
<u>Tomatoes</u>		<u>000/T</u>	
1	California	3,341.7	66.5
2	Ohio	545.7	10.9
3	Indiana	295.2	5.9
4	New Jersey	280.0	5.6
5	Pennsylvania	151.0	3.0
	Other States	411.0	8.1
	Total	5,024.6	100.0
<u>Snap Beans</u>		<u>000/T</u>	
1	Oregon	132.2	23.2
2	New York	102.6	18.0
3	Wisconsin	99.7	17.5
4	Tennessee	23.9	4.2
5	Michigan	20.0	3.5
	Other States	191.3	33.6
	Total	569.7	100.0
<u>Sweet Corn, in husk</u>		<u>000/T</u>	
1	Minnesota	513.6	27.4
2	Wisconsin	449.3	24.0
3	Oregon	208.9	11.2
4	Illinois	174.4	9.3
5	Washington	147.9	7.9
	Other States	377.0	20.2
	Total	1,871.1	100.0
<u>Peas, green, shelled</u>		<u>000/T</u>	
1	Wisconsin	137.6	28.9
2	Washington	95.6	20.1
3	Minnesota	71.5	15.0
4	Oregon	42.4	8.9
5	Idaho	15.0	3.1
	Other States	114.2	24.0
	Total	476.3	100.0

Table III-2. Vegetables for Processing, Principal Production Areas.
Volume and Percentage of Total Production in Leading States^{1/}
(continued)

Product	State	Volume	% of Total
<u>Cabbage for Kraut</u>		<u>000/T</u>	
1	New York	90.9	35.2
2	Wisconsin	72.8	28.2
3	Ohio	32.5	12.6
	Other States	61.8	24.0
	Total	258.0	100.0
<u>Beets</u>		<u>000/T</u>	
1	New York	78.8	38.0
2	Wisconsin	60.5	29.2
3	Oregon	35.7	17.2
4	Texas	15.9	7.7
	Other States	16.2	7.9
	Total	207.1	100.0
<u>Sweet Potatoes</u>		<u>000/cwt.</u>	
1	Louisiana	4,165	29.6
2	North Carolina	4,000	28.4
3	Virginia	1,041	7.4
4	Texas	1,040	7.4
5	Mississippi	990	7.0
	Other States	2,850	20.2
	Total		100.0
<u>Lima Beans</u>		<u>000/T</u>	
1	California	30.9	39.9
2	Delaware	11.7	15.1
3	Wisconsin	6.4	8.3
4	Washington	4.7	6.1
	Other States	23.7	30.6
	Total	77.4	100.0

Table III-2. Vegetables for Processing, Principal Production Areas.
Volume and Percentage of Total Production in Leading States^{1/}
(continued)

Product	State	Volume	% of Total
<u>All Vegetables</u>		<u>000/T</u>	
1	California	3,564.5	38.3
2	Wisconsin	877.2	9.4
3	Ohio	631.6	6.8
4	Minnesota	600.4	6.4
5	Oregon	448.6	4.8
	Other States	3,194.9	34.3
	Total	9,317.2	100.0

^{1/} Source: Statistical Reporting Service, U. S. Department of Agriculture

2. Fruit Production

Nearly every state is a commercial producer of some kind of fruit, but production is concentrated in relatively few states. Citrus fruit production is limited geographically; production of deciduous fruits and berries is distributed more widely. Although total fruit production has trended generally upward, three geographic regions have gained in relative importance since 1950. The Pacific region gained from 37 percent of total fruit acreage in 1950 to 42 percent in 1964. The South Atlantic region showed an even more pronounced increase--up from 22 to 30 percent of total fruit acreage. The Mountain region had a slight increase in total acreage but just held its own in relative terms.

Seven states (California, Florida, Washington, New York, Michigan, Oregon and Pennsylvania) accounted for 88 percent of total U. S. fruit tonnage 1967-69.

The leading states in the production of major fruits and berries are shown in Exhibit III-3 and Table III-3. As was the situation for vegetables, a high degree of concentration in production is seen, as follows:

Citrus	-	Florida - 71.3 percent, California - 20.7 percent
Peaches	-	California - 62.2 percent
Strawberries	-	California - 55.4 percent, Oregon - 14.4 percent
Pears	-	California - 47.7 percent, Washington - 25.9 percent
Apples	-	Washington, New York and Michigan - 48.4 percent

Similar concentrations exist for other fruits and berries

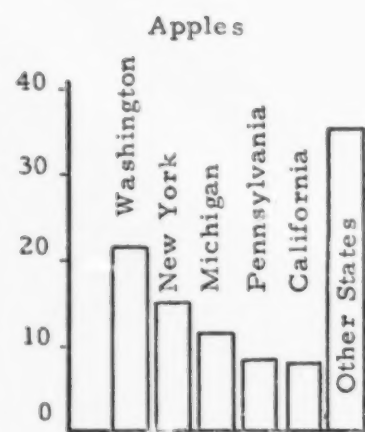
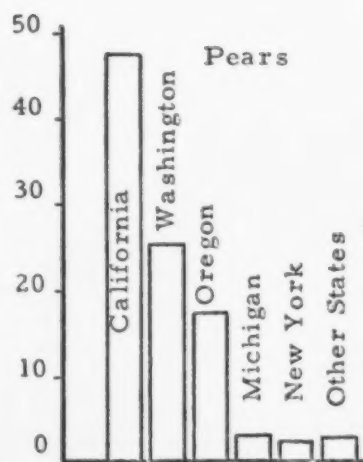
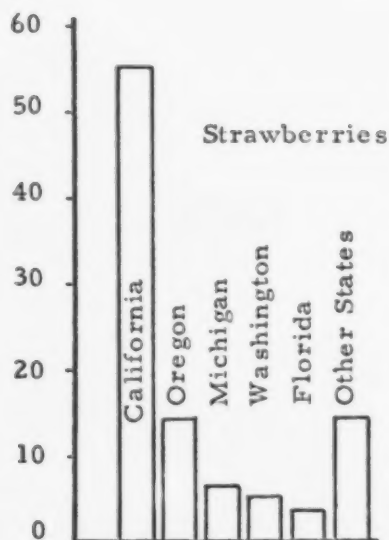
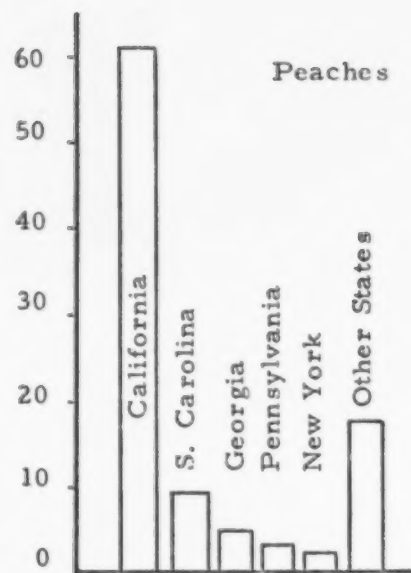
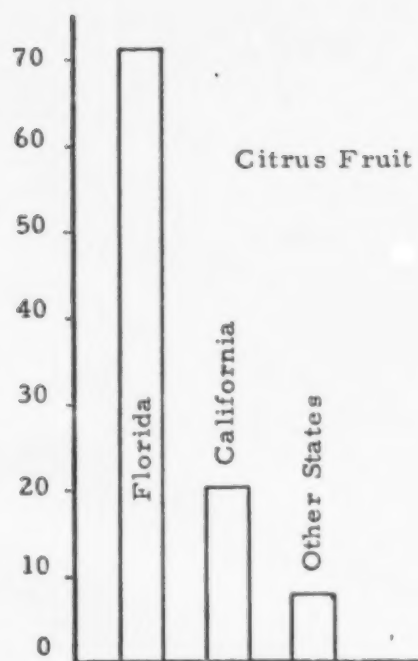


Exhibit III-3. Major Fruits, Leading States, 1970
Percent of Total Production in Each State

Source: Statistical Reporting Service, U. S. Department of Agriculture.

Table III-3. Major Fruits, Principal Production Areas.
Volume and Percentage of Total Production
in Leading States^{1/}

Product	State	Volume	% of Total
<u>Peaches (1969)</u>		<u>000/T</u>	
1	California	1,140.0	62.2
2	S. Carolina	169.0	9.2
3	Georgia	87.6	4.8
4	Pennsylvania	60.6	3.3
5	New York	52.2	2.8
	Other States	323.3	17.7
	Total	1,832.7	100.0
<u>Strawberries</u>		<u>000/Ton</u>	
1	California	134.4	55.4
2	Oregon	35.0	14.4
3	Michigan	16.7	6.9
4	Washington	13.0	5.4
5	Florida	8.0	3.3
	Other States	35.7	14.6
	Total	242.8	100.0
<u>Pears</u>		<u>Tons</u>	
1	California	258,000	47.7
2	Washington	140,000	25.9
3	Oregon	95,000	17.6
4	Michigan	17,000	3.1
5	New York	14,500	2.7
	Other States	16,750	3.0
	Total	541,250	100.0
<u>Apples</u>		<u>Million/lbs.</u>	
1	Washington	1,370	21.6
2	New York	955	15.0
3	Michigan	750	11.8
4	Pennsylvania	525	8.3
5	California	520	8.2
	Other States	2,229	35.1
	Total	6,349	100.0

Table III-3. Major Fruits, Principal Production Areas.
Volume and Percentage of Total Production
in Leading States^{1/} (continued)

Product	State	Volume	% of Total
<u>Citrus Fruits</u>		<u>000/T</u>	
1	Florida	8,004	71.3
2	California	2,319	20.7
	Other States	893	8.0
	Total	11,216	100.0

^{1/} Source: Statistical Reporting Service, U. S. Department of
Agriculture.

C. Number and Locations of Firms/Plants

Fruit and vegetable canning and freezing plants are widely dispersed throughout the United States. The 1971 Directory of the Canning, Freezing and Preserving Industries, ^{1/} an authoritative listing of commercial fruit and vegetable canning or freezing plants, shows plants in all states except Nevada, New Mexico and South Dakota.

1. Fruit and Vegetable Canning Plants

The Census of Manufacturers enumerates plants (establishments) throughout the United States at five-year intervals. Comparison of data over the period 1937-1967 indicates a continued decline in the number of operating canning plants, from 2359 in 1937 to 1223 in 1967 (Table III-4 and Exhibit III-3a). Extrapolation of this trend would indicate 1165 plants in 1970 (this agrees approximately with the number in the Directory ^{1/}, 990 in 1975 and 800 in 1980.

From Table III-4 it is seen that the number of canning plants in 1967 was approximately half that in 1937 and there has been a 25 percent decrease in the past ten years.

There has been a slight shift in relative regional importance, with the West and South gaining slightly over the East and Midwest. This trend is also expected to continue during the 1970's. Expansion of commercial fruit and vegetable production in the West and efforts being made to diversify agricultural production (out of cotton) in the South will be major factors. In comparison with 1947 and 1967, by 1980 the regional distribution of canning plants is expected to be as follows:

<u>Region</u>	<u>Percent of Total Plants</u>		
	<u>1947</u>	<u>1967</u>	<u>1980</u>
East	19.2	20.3	18.8
Midwest	27.8	27.9	26.8
South	34.8	27.5	28.1
West	18.2	24.3	26.3

The largest number of plants (1967) was still in the Midwest (341) although the South (336) was close behind. The leading states in 1967 were:

^{1/} The Directory of the Canning, Freezing and Preserving Industries, 1970-71, Edward E. Judge & Sons, Winchester, Maryland.

Table III-4. Trends in number of fruit and vegetable canning plants, United States and major geographic regions, 1937-1967 and projections to 1980^{1/}

Region	Number of canning plants							
	Number reported by Census of Manufacturers				Projections			
	1937	1947	1954	1958	1963	1967	1970	1980
Total, United States	2359	2265	1758	1607	1430	1223	1165	990
New England	N.A.	107	80	77	64	48	230	190
Middle Atlantic	N.A.	309	275	271	239	200	190	150
East North Central	N.A.	561	482	408	353	299	325	280
West North Central	N.A.	140	71	51	51	42		215
South Atlantic	N.A.	482	337		277	238		
East South Central	N.A.	51	37	South	20	16		
West South Central	N.A.	221	112	436	88	82	320	270
Mountain	N.A.	74	59	65	47	36		
Pacific	N.A.	320	305	299	291	262	290	250
								210

^{1/} Source: U. S. Department of Commerce, Bureau of the Census, Census of Manufacturers.

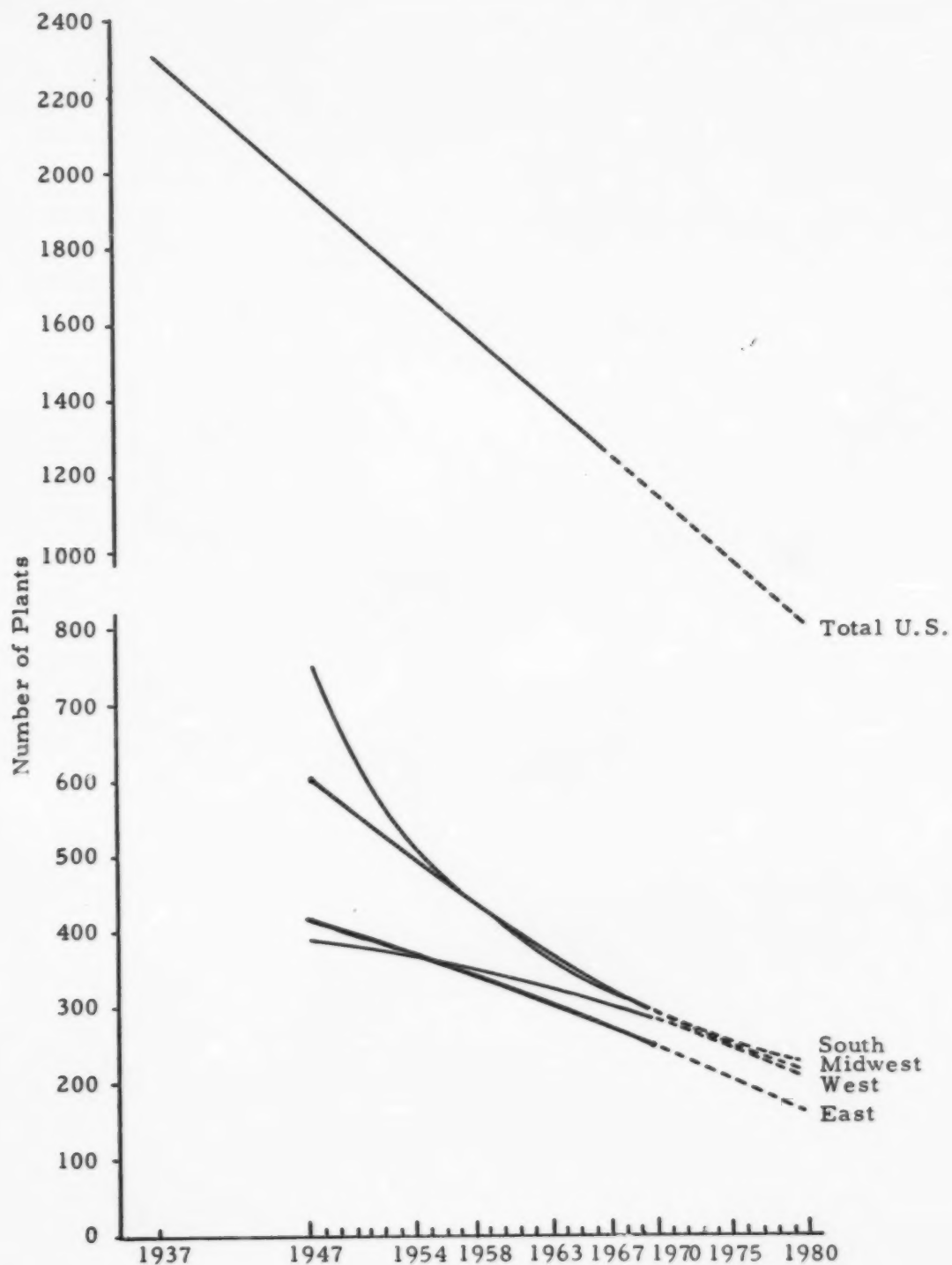


Exhibit III-3a. Base line trends, number of fruit and vegetable canning plants, United States and major geographic regions, 1937-1967 with projections to 1980.

<u>State</u>	<u>No. Plants 1967 Census</u>
California	170
New York	106
Wisconsin	91
Florida	69
Maryland	65

The Directory of the Canning and Freezing Industries, 1970-71 lists 1018 plants distributed among 710 firms.

2. Fruit and Vegetable Freezing Plants

The freezing industry is of relatively recent origin and has made its most rapid growth in the past 20 years. From a small industry of 21 plants, the freezing of fruits and vegetables expanded rapidly through the 1940's, 291 plants being reported in the 1947 Census of Manufacturers. (Table III-5 and Exhibit III-3b). The industry remained relatively stable during the early- and mid-fifties but then started a period of rapid growth, reading 426 plants in 1958 and 650 in 1963. Some decrease has been noted in recent years as plants have grown larger and small, obsolete plants abandoned, and in 1967, 608 plants were reported in operation. It is projected that the trend toward a smaller number of larger plants will continue during the 1970's. An industry of 580 plants is projected for 1970, 545 plants in 1975 and 505 plants in 1980.

There was little change in the regional distribution of freezing plants during the 1960's. However, a slight shift to the West and South is expected as vegetable and fruit production increases in those areas.

<u>Region</u>	<u>Percent of Total Plants</u>		
	<u>1963</u>	<u>1967</u>	<u>1980</u>
East	22.3	22.2	21.0
Midwest	23.6	23.8	22.5
South	21.5	21.4	22.5
West	32.6	32.6	34.0

In 1967, California had the most plants (85), followed by New York (47), Washington (46), Illinois (36), Michigan (34) and Oregon and Pennsylvania had 33 plants each.

Table III-5. Trends in number of fruit and vegetable freezing plants, United States and major geographic regions, 1937-1967 and projections to 1980^{1/}

Region	Number of freezing plants									
	Number reported by Census of Manufacturers					Projections				
	1937	1947	1954	1958	1963	1967	1970	1975	1980	
Total, United States	21	291	266	426	650	608	580	545	505	
New England	N.A.	23	6	24	30	32	128	117	106	
Middle Atlantic	N.A.	47	51	71	15	103				
East North Central	N.A.	)	)	49	112	113	125	121	114	
West North Central	N.A.	)	)	19	41	32				
South Atlantic	N.A.	33	39	61	81	70				
East South Central	N.A.	21	15	22	19	17	136	125	113	
West South Central	N.A.	25	15	26	40	43				
Mountain	N.A.	)	9	15	32	33	191	182	172	
Pacific	N.A.	)	101	139	180	165				

^{1/} Source: U. S. Department of Commerce, Bureau of the Census, Census of Manufacturers.

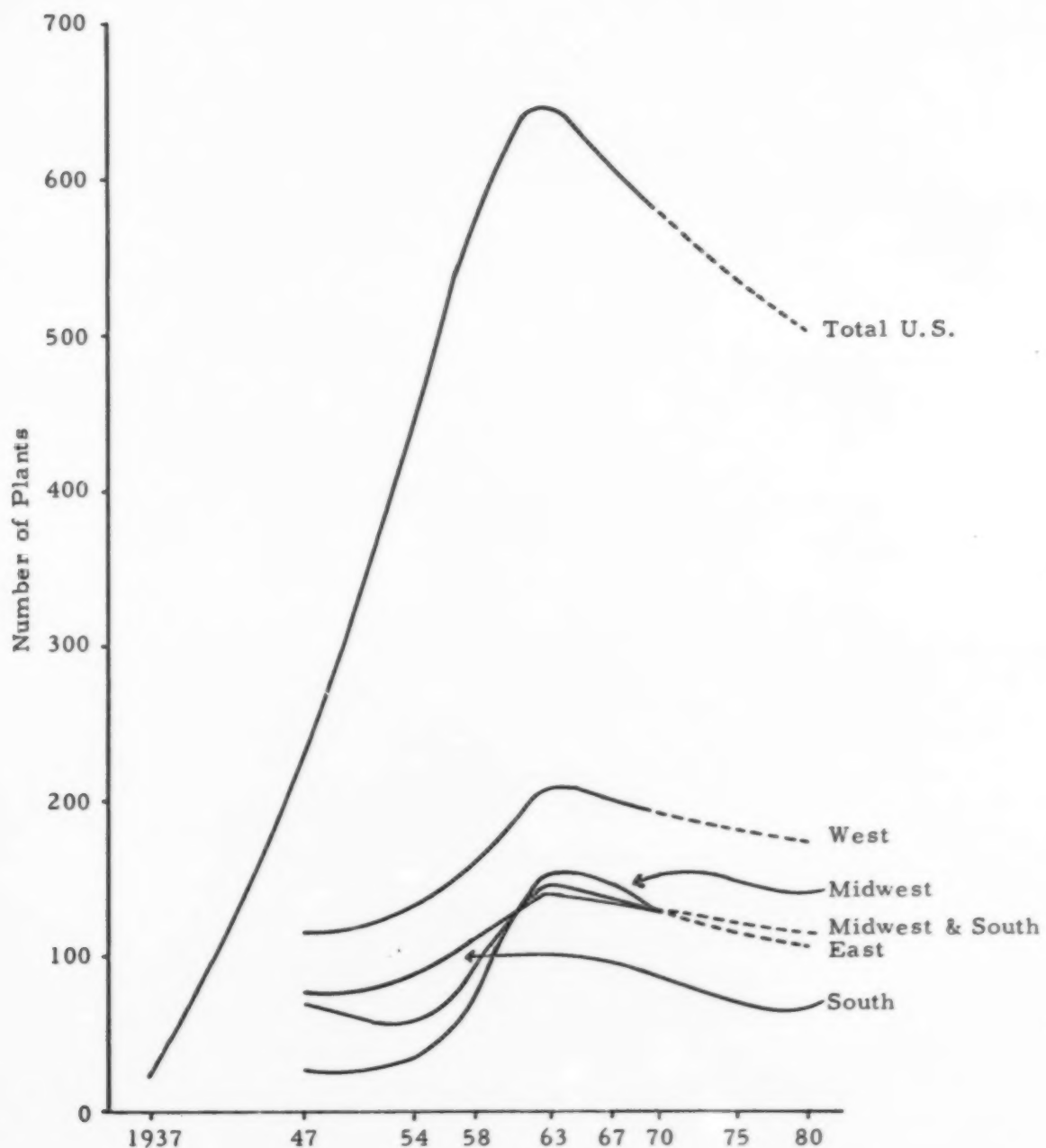


Exhibit III-3b. Base line trends, number of fruit and vegetable freezing plants, United States and major geographic regions, 1937-1967 with projections to 1980.

D. Characteristics of Fruit and Vegetable Canning and Freezing Firms

Fruit and vegetable canning and freezing firms vary greatly in size, organizational structure, product mix processed, and degree of diversification and integration. The firms and plants considered in this analysis were mainly primary processors of the products with which the study was concerned.

1. Size of Firms

Canners - A detailed analysis was made of the volume packed (in terms of cases of canned product) for 598 canners. It should be emphasized that this analysis is in terms of physical volume rather than gross sales. To avoid any possible disclosure of individual operations, only industry totals for seven volume categories were considered. Table III-6 indicates the number of firms in each volume category.

Table III-6. Size Distribution, Fruit and Vegetable Canning Firms, 1970

Size Category (Annual volume cases canned product)	Number of Firms	Percent of Total
Under 100,000	106	17.6
100,000 - 250,000	108	18.1
250,000 - 500,000	114	19.1
500,000 - 1,000,000	99	16.6
1,000,000 - 2,000,000	66	11.0
2,000,000 - 5,000,000	44	7.4
Over 5,000,000	61	10.2
Total	598	100.00

Source: The Directory of the Canning, Freezing and Preserving Industries, 1970-71

Over a third of the firms analyzed (35.7%) would be considered as small canners with an annual pack of less than 250,000 cases. At the other end of the range, 28.6 percent packed over 1,000,000 cases and would be classed as large and 10 percent of the canners packed over 5 million cases annually and would be considered in the very large group.

Freezers - Volume data were available from 231 fruit and vegetable freezing firms. The distribution of sizes of these firms is shown in Table III-7.

Table III-7. Size Distribution, Fruit and Vegetable Freezing Firms, 1970

Size Category (Annual volume million pounds)	Number of Firms	Percent of Total
Under 2	43	15.8
2 - 5	41	15.1
5 - 10	30	11.1
10 - 20	31	11.4
20 - 50	37	13.7
50 - 100	27	10.0
Over 100	62	22.9
	<u>271</u>	<u>100.</u>

Source: The Directory of the Canning, Freezing and Preserving Industries, 1970-71

Approximately 30 percent of all firms analyzed would be classed as small freezers, with annual volume of less than 5 million pounds. However, 46.6 percent would be considered large (annual volume in excess of 20 million pounds) and 22.9 percent would be in the very large category with annual packs in excess of 100 million pounds.

2. Concentration of Processing Operations

Local area processing concentration has little meaning to the fruit and vegetable canning and freezing industries. Plants and firms located in any one region are potential competitors to those producing the same product lines in all other regions.

Canners - The canning industry is characterized by a large number of firms. Consequently the small canners share a small segment of the total market. In addition, concentration is much higher on a product than on a firm basis. Exhibits II-4 through II-13 show the relationship between plant locations, plant size and degree of production concentration for each size group for selected fruit and vegetable products.

All plants producing given products were divided into three equal groups according to size. One-third of the total number of plants were classed in the "upper third" or large size group. One-third fell into the "middle third" or medium size group; and one third went into the "lower third" or small size group.

Exhibit II-4, snap beans, shows the general location of plants processing snap beans, by size group, and the concentration ratio indicates that the upper third (one-third largest plants) produced 74 percent of the total snap bean pack, the middle third produced 21 percent and the lower third (small plants) only accounted for 5 percent of the total snap bean pack.

A similar degree of concentration was found for other products considered:

<u>Exhibit</u>	<u>Product</u>	<u>Percent of total pack produced by the upper third (large) plants</u>
III-4	Snap beans	74%
III-5	Sweet corn	76%
III-6	Beets	74%
III-7	Green peas	84%
III-8	Tomatoes (excl. Calif.)	66%
III-9	Sweet potatoes	77%
III-10	Catsup, (excl. Calif.)	87%
III-11	Tomato juice, (excl. Calif.)	84%
III-12	Apples	85%
III-13	Apple sauce	79%

Although similar data are not available for all canned products, nor for frozen products, the consistency of concentration, in those products for which data were available, is such that it appears that for most canned and frozen fruits and vegetables the top third (by number and size) of the firms will process 75-85 percent of the total pack and the lower third will account for only 5-6 percent.

3. Single plant vs. Multiplant Firms

Canners - A total of 710 firms were analyzed and these firms operated 1,018 plants. Classification of firms according to the number of plants (separate factories) per firm, yielded the following distribution:

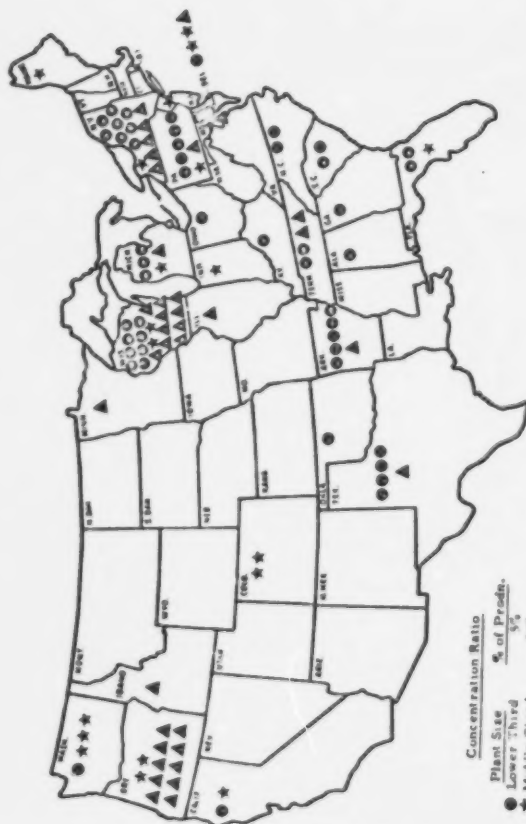


Exhibit III-4 Snap Beans, Relationship Between Plant Numbers, Relative Size and Total Volume of Production.

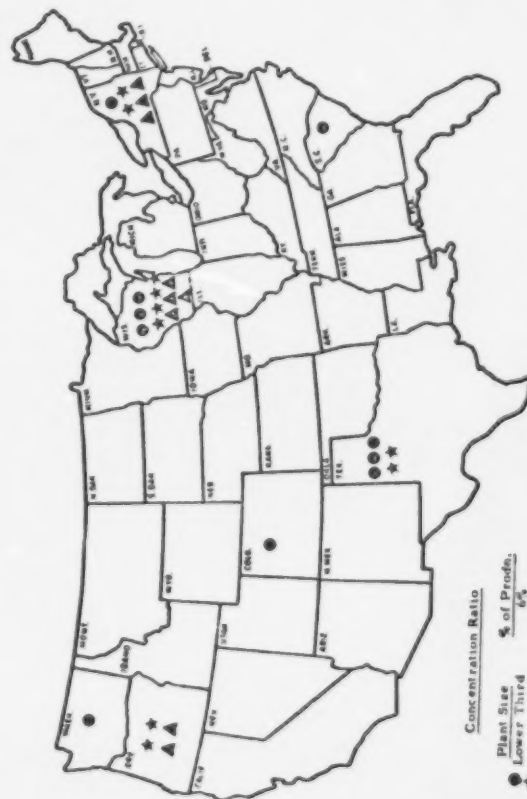


Exhibit III-6 Beans, Relationship Between Plant Numbers, Relative Size and Total Volume of Production.

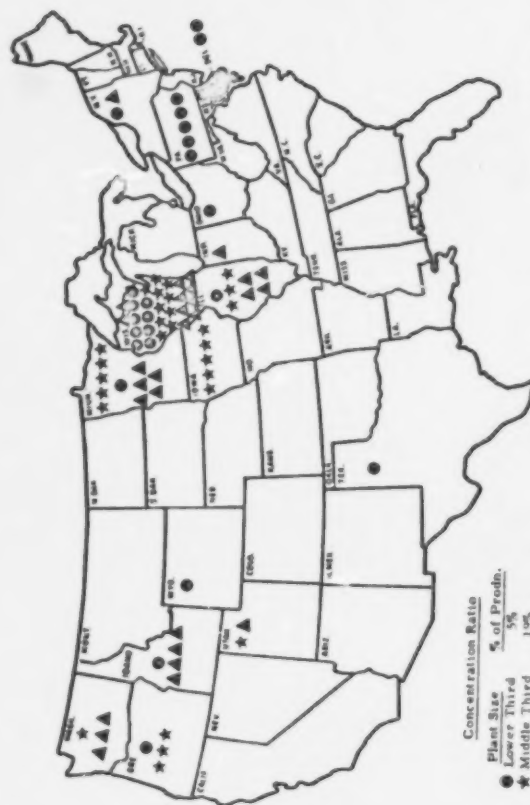


Exhibit III-8 Sweet Corn, Relationship Between Plant Numbers, Relative Size and Total Volume of Production.

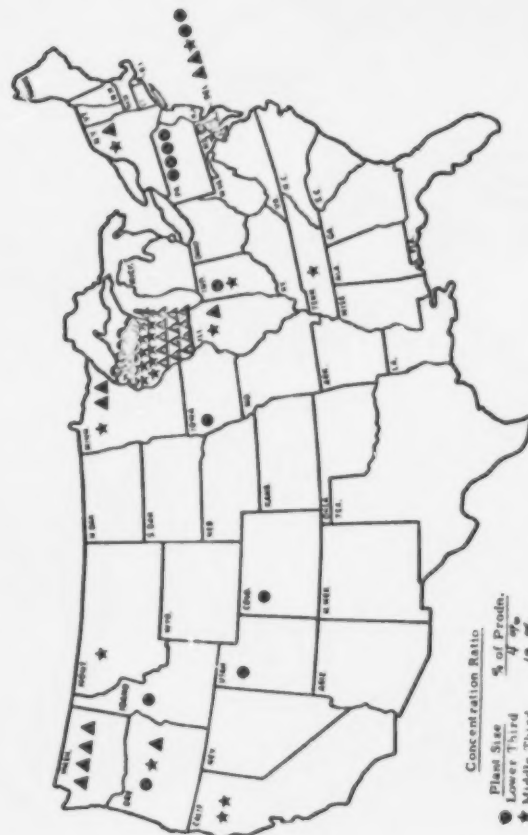


Exhibit III-7 Green Peas, Relationship Between Plant Numbers, Relative Size and Total Volume of Production.

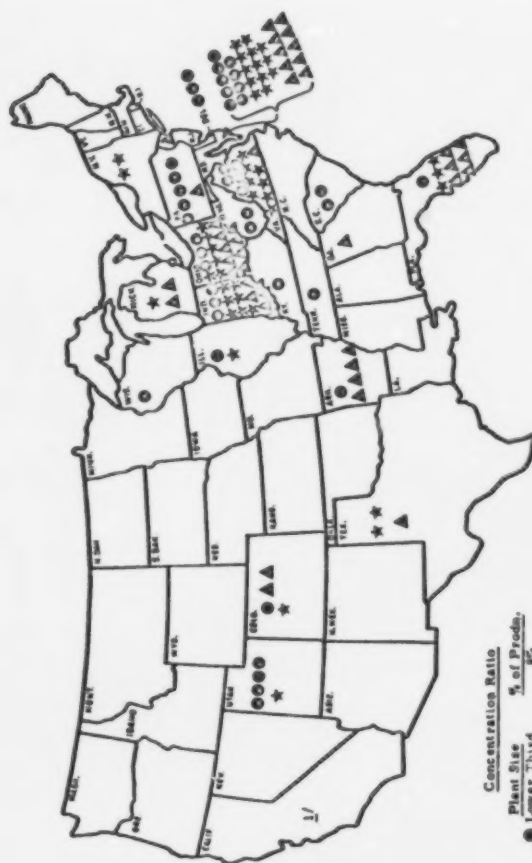


Exhibit III-8. Tomatoes, Relationship Between Plant Members Relative Size and Total Volume of Production.

1/ Data not available for California.

Exhibit III-9. Sweet Potatoes, Relationship Between Plant Members, Relative Size and Total Volume of Production.

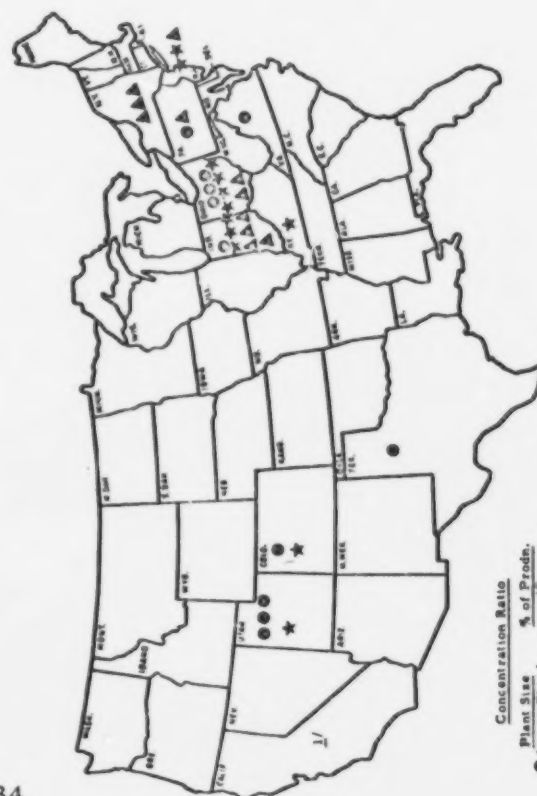


Exhibit III-10. Cateup, Relationship Between Plant Members, Relative Size and Total Volume of Production.

1/ Data not available for California.

Exhibit III-11. Tomato Juice, Relationship Between Plant Members, Relative Size and Total Volume of Production.

1/ Data not available for California.



Exhibit III-12 Apples. Relationship Between Plant Members, Relative Size and Total Volume of Production.

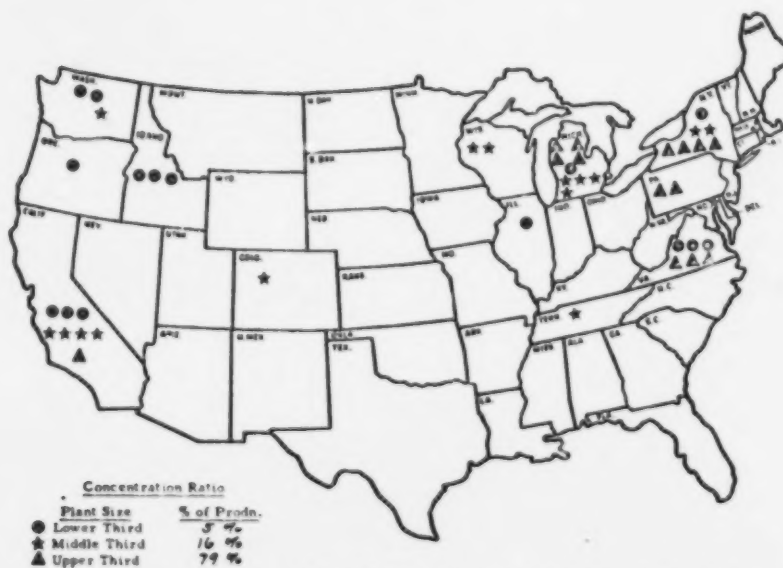


Exhibit III-13 Applesauce. Relationship Between Plant Members Relative Size and Total Volume of Production.

<u>No. Plants Per Firm</u>	<u>No. Firms</u>	<u>% of Total</u>
Single plant	604	85.1
2 plants	36	5.1
3 - 5 plants	54	7.6
6 - 10 plants	8	1.1
11 plants or more	8	1.1
Total multiple plant firms	106	14.9

The two largest firms each operated 31 plants, one firm had 24 plants, two had 17 plants and one had 16 plants. In contrast, 85.1 percent of the canning firms operated only one plant.

Freezers - The operations of 250 fruit and vegetable freezing firms were reviewed and it was found that these firms operated a total of 339 plants, with a plants-per-firm distribution as follows:

<u>No. Plants Per Firm</u>	<u>No. Firms</u>	<u>% of Total</u>
Single plant	205	82.0
2 plants	25	10.0
3 - 5 plants	15	6.0
6 - 10 plants	5	2.0
Total multiple plant firms	45	18.0

The largest firm operated 9 plants, the second largest 8, third 7 and the other two large firms had 6 plants each. Again, the data show that the freezing industry consists mainly of single plant firms.

4. Single-Product vs. Multiple-Product Plants

Canners - Most canning plants were multiple-product plants. Out of a total of 1,018 plants, 656 or 64.4 percent packed more than one product.

Distribution of number of different products processed per plant was as follows:

<u>No. Products</u>	<u>No. Plants</u>	<u>% of Total</u>
1	362	35.6
2	252	24.8
3	193	19.0
4	99	9.7
5	53	5.2
6	24	2.3
over 6	35	3.4
Total	1,018	100.0

Freezers - About the same proportion of freezers operated multiple-product plants as was true for canners. Out of 339 plants, 195 or 57.5 percent were multiple product operations.

Distribution of the number of different fruit and vegetable products processed per plant was as follows:

<u>No. Products</u>	<u>No. Plants</u>	<u>% of Total</u>
1	144 q	42.5
2	88	26.0
3	39	11.5
4	25	7.4
5	19	5.6
6 or more	24	7.0
Total	339	100.0

5. Diversified vs. Specialized Plants

Although the previous section indicates that most canners and freezers operate multiple-product plants and can a diversified line of fruits, vegetables and juices, these industries are nevertheless highly specialized in the processing of fruits and vegetables. A part of this specialization is location-oriented in that they are located in centers of fruit and vegetable production and another part is equipment-oriented since specialized equipment is required.

The Bureau of the Census calculates specialization ratios for different types of industries. These represent the ratio of sales value of all the primary products of the plant to its total of primary plus secondary products.

Canners - In 1967, the specialization ratio for fruit and vegetable canning plants was calculated to be 90 percent. This indicates that canned fruits, vegetables and juices represented 90 percent of the value of gross sales of these plants. Secondary products shipped by this industry consist mainly of canned food specialty products and frozen fruits and vegetables.

Freezers - This industry's production of frozen fruits and vegetables (primary products) in 1967 represented 92 percent (specialization ratio) of its total product shipments. Secondary products consisted mainly of canned fruits and vegetables and dehydrated food products.

6. Stage in Production Process

By definition, this analysis has been limited to primary canners and freezers of fruits, vegetables and juice products. These processors start with raw product (fruits or vegetables) as such products come from the farms and orchards where they are grown.

No consideration has been given to reprocessors, who buy vegetable or fruit puree or other semi-finished products, and manufacture jams, jellies, soups, etc. Also no consideration has been given to the prepared "convenience" food industry which prepares "heat-n-serve" dinners, specialty dishes or other fabricated food items using processed fruit or vegetable products as a base.

The data used throughout this analysis are intended to represent primary processing operations.

7. Degree of Integration

There is only a relatively small amount of vertical integration in the fruit and vegetable canning and freezing industries. Based on a special canner survey by the Economic Research Service, U. S. Department of Agriculture in 1964, it was estimated that only 8 percent of the fruits and vegetables canned were obtained from land owned or rented by canners. A comparable situation existed in the freezing industry where only 9 percent of the raw product was obtained from freezer-owned or rented land.

Over two-thirds of the supply of fruits and vegetables processed by canners and freezers is obtained through contractual arrangements with growers. Contracting with growers has provided a means whereby canners and freezers can reduce the risk of raw product supply variations from year to year without investing capital resources directly into farm production. Thus they avoid the necessity of integrating backward into production.

Canners and freezers also have never integrated very far forward into wholesale and retail trade. Some large processors do maintain sales offices in principal wholesale markets, but as was reported earlier in this study, brokers handle over two-thirds of the sales of processed fruits and vegetables.

E. Employment

The fruit and vegetable canning and freezing industries are major employers of labor in the areas in which they operate. Further, they employ a high proportion of low-skilled seasonal workers in relation to total employment in the industry. As a result, curtailment of these processing industries would have an important impact on employment in the lower income levels in the areas concerned.

Number of Employees

Canning Industry - Total employment in fruit and vegetable canning plants in 1967 (the latest Census year) was 100,100 down from 108,400 ten years earlier. However, the average number of employees per plant had increased from 66 to 82 reflecting increases in size of operations. Eighty-nine percent of total employment consisted of production workers, up one percent from 1958. Sixty percent of the plants employed more than 20 people in 1967 compared with 57 percent in 1958.

Freezing Industry - In contrast to the canning industry where total employment has decreased, employment in the fruit and vegetable freezing industry increased from 39,500 in 1958 to 64,500 in 1967, a gain of 63 percent. Average number of employees per plant increased from 93 in 1958 to 106 in 1967, again reflecting increases in scale of operations. Production workers in 1967 represented 91 percent of total employment, up 3 percent over 1958. Sixty percent of the plants employed 20 or more people.

Payrolls

Canning Industry - In 1967, annual payroll in the canning industry totaled \$473,800,000, an average of \$387,000 per plant. Production payrolls equalled 79 percent of total payroll. The average annual earnings per employee was \$4,732.

Freezing Industry - Total annual payroll in the fruit and vegetable industry in 1967 was \$295,200,000, an average of \$485,000 per plant. Production payrolls equalled 78 percent of total payroll. Average annual earnings per employee was \$4,576.

F. Industry Capacity and Utilization of Capacity

Capacity is defined as the output which a canning or freezing plant is capable of producing during a given time under specified conditions. Normal capacity

is the output per unit of time which can be realized under usual operating conditions. Maximum capacity is the greatest output obtainable, per unit of time, with existing plants and equipment. Excess capacity equals capacity minus volume actually processed through a plant during a given time period.

Utilization of capacity is the degree to which normal capacity is attained in the output of a plant during a given period.

Utilization of capacity is an important factor in the financial success of a given plant and utilization is affected by a number of supply, operating and sales factors. These factors are summarized in Table III-8.

Little information is available concerning capacity and utilization of capacity in canning and freezing plants. The only authoritative study in this area was done in the Southern Region.^{1/} Pearson found that canning plants in the South utilized only 57 percent of their vegetable processing capacity against 74 percent for freezers. As a general rule, the plants largest in size utilized a greater portion of their capacity.

Due to the fact that there is substantial year-to-year variation in the production of fruits and vegetables, 10-20 percent excess capacity, above normal, is desirable to enable the industry to process the production of larger-than-normal years.

By increasing processing line rates per hour and by extending hours worked or by adding shifts, it was estimated that canning plants could increase their capacity above "normal" levels by 25 percent or more.

In summary, it is apparent that appreciable excess capacity exists in both the canning and freezing industries. In general, utilization of capacity is higher in larger plants and in intensive, commercial production areas.

^{1/} Pearson, James L., "Utilization of the South's Vegetable Processing Capacity, Department of Agr. Econ., Fla. Agr. Exp. Sta. and Econ. Res. Sv., USDA, Ag Econ. Res. Rpt. EC68-5, January 1968.

Table III-8. Summary of Factors Affecting Utilization of Capacity
Within Fruit and Vegetable Processing Plants

Factor	Comments
1. Length of Harvest Season by Product	Year to year variation exists
2. Distribution of Raw Product Supplies Within Harvest Season	Varies from year to year, but generally peaks within season. Delays occur from lack of availability
3. Sales demand	Year to year variation affects planned pack
4. Raw Product Quality/Recovery Percentage	Percent of raw product recovered varies product quality
5. Level of Maturity of Raw Product	Can vary within a season and affects quality
6. Degree of Additives to the Raw Product	May alter normal utilization in terms of raw product processed.
7. Productivity of Labor/Job Performance	Varies somewhat and effects utilization of plant capacity
8. Number of Products & Schedule	Multiproduct plants may have overlapping and competing seasons. Capacity is affected by definition.
9. Variations in container Sizes	Affects raw product volume capacity
10. Warehouse and Inventory Conditions	Plant schedules may vary with associated warehouse space and/or inventory conditions

Table III-8.(continued)

Factor	Comments
11. General Operating Conditions	
a) Length of season	Total capacity varies accordingly
b) Length of operating shifts	Capacity/hour varies by length of shift
c) Number of shifts/day	Affects total daily capacity
d) Number of days/week	Affects overall total capacity
e) Scheduled work-breaks	A source of delay affecting capacity utilization
f) Unscheduled work delays	Equipment failures or other factors (e. g., product availability) affect utilization
g) Nature and Organization of equipment	Variation among plants occurs partly due to age, size, level of technology and the general organization of plant equipment
h) Maintenance requirements	Scheduled maintenance requirements vary by plant and may limit normal capacity utilization

G. Industry Segmentation

Canning Plants

The industry was segmented into representative groups by volume of production. Information was obtained from the National Cannery Association on the number of plants producing each of the major canned commodities and the percent of total volume produced by the largest 33.3 percent of the plants, the middle 33.3 percent and the smallest 33.3 percent. The total number of cases produced in 1970 was then used to develop the average number of cases produced by a representative sized plant in each third of the industry. The results are shown in Table III-9.

Plants in the largest third size category in the canning industry produced 78.5 percent of the volume. The average volume for this plant group ranged from 500,000 cases to 1,500,000 cases per year with the exception of the catsup plants which averaged 3,105,000 cases. It was assumed that these plants operated on the basis of 1,000 hours per year and thus averaged in the range of 500 to 1,500 cases per hour.

The middle third of the plants averaged 17.2 percent of the total volume which ranged from 125,000 to 300,000 cases per year. Catsup was again the exception with 437,000 cases. These plants normally operate on a shorter season than the large plants and were assumed to operate on the basis of a 750 hour year. This placed the average hourly pack for the medium-sized firm in the range of 170 to 400 cases per hour.

Small plants pack on the average only 4.3 percent of the industry total. This amounts to 36,000 to 79,000 cases for the major commodities with apples and apple juice somewhat less. Generally these plants operate on the shortest pack season of all plants and then were assumed to operate on a 500 hour season. On an hourly basis this amounted to about 95 to 140 cases per hour.

The average volume of single strength citrus juice was reported by the Florida Citrus Commission at 414,000 cases. These plants were assumed to operate on a 1,000 hour season and following some basic size classification a large plant was assumed to process 1,000,000 cases per year, the middle size group 400,000 cases and the smallest size grouping 200,000 cases.

Table III-9. Average Pack Size for Large, Medium and Small Size Canning Plants by Selected Commodities, 1970

Product	Number of Cases (1,000 24/303 Eq)	Number of Plants	Percent of Total Pack Produced by						Average Pack Size		
			Largest			Middle			Smallest		
			Third	Third	Third	Third	Third	Third	Third	Third	Third
			(1,000 24/303 Eq)								
Sweet Corn	46,995	88	76	19	5			1,232	298	47	
Green Beans	43,189	109	74	21	5			888	245	48	
Catsup	40,020	34	87	12	1			3,165	437	36	
Tomatoes	39,017	133	66	26	8			585	225	71	
Tomato Juice	35,952	60	84	13	3			1,510	180	54	
Green Peas	28,697	71	84	12	4			1,004	125	48	
Applesauce	23,646	46	79	16	5			1,245	236	79	
Beets	11,338	29	74	20	6			839	227	76	
Sweet Potatoes	9,846	29	77	19	4			758	208	39	
Apples	3,679	20	85	12	3			447	63	18	
Apple Juice	14,472	49	78	19	3			700	172	27	

Freezing Plants

Unfortunately precise production data for freezing plants is not available but general size classification is given in the Directory of the Canning, Freezing and Preserving Industries (Chapter III, Section D). Approximately the smallest 30 percent of the freezing plants produce less than 5 million pounds (equivalent to 200 thousand cases, 24/303 equivalent). The middle 22.5 percent produce between 5 and 20 million pounds or equivalent to 200 to 800 thousand cases. Forty-six percent of the firms produce in excess of 20 million pounds with 23 percent in the over 100 million pound category. The multiproduct canning plant used in the analysis in Part III represents the medium size category with an annual volume of approximately 15 million pounds.

The Florida Citrus Commission reported data on the average volume of plants processing concentrated frozen orange juice. This is reported for 1970 at 716,000 cases of 48/6 or a total frozen product weight of 17.9 million pounds. Small and large plants were then assumed to process .2 and 1.5 million cases respectively or 5.0 and 37.5 million pounds.

H. The Financial Position of the Industry

The food canning and freezing industries in the United States are highly competitive with a large number of relatively small firms. Profit margins on sales are low and highly volatile both for individual plants and for the industry as a whole. Detailed information on the profit position of respective type and size companies is simply not available and only broad industry averages can be obtained.

A composite income statement for canned fruits and vegetable (SIC2033) was obtained from the National Canners Association and is presented in Table III-10. No similar statement has been obtained for the freezer industry. Total sales in the canned fruits and vegetable industry amount to \$3.7 billion. Labor costs amount to \$613 million or 16.6 percent of sales. This has increased from 15.4 percent of sales in 1965. Fresh fruit and vegetable costs declined sharply in 1969 and 1970 to 21.4 percent. Profits were also lower during the past three years and averaged 2.3 percent of sales compared with an average of 4.0 percent during the 1965 through 1967 period. According to earlier survey of income and earnings over a five year period by the National Canners Association, an average of 54 firms operated on a profitable basis each year and an average of 10 firms operated on a loss basis or about 16 percent.

Table III-10. Income Statement, Canned Fruits and Vegetables (SIC 2033)

	1965	1966	1967	1968	1969	1970
	Millions of Dollars					
Sales	2,982.0	3,215.8	3,467.8	3,654.1	3,670.1	3,700.0
Labor cost	457.9	492.5	536.4	582.9	594.6	613.4
Wages	317.8	341.1	376.0	409.5	419.5	424.5
Salaries	89.3	92.8	97.8	106.5	104.9	114.6
Supplementary labor costs	50.8	58.5	62.6	66.9	70.2	74.3
Materials & other costs	2,343.7	2,527.4	2,725.7	2,881.9	2,943.4	2,916.4
Fresh fruits & vegetables	702.9	769.5	812.7	876.6	810.7	793.2
Other food ingredients			170.5			
Containers	571.4	614.5	627.5	708.5	720.8	728.2
Other materials, supplies, etc.			443.8			
All other costs			671.2			
Depreciation	63.7	62.0	72.0	77.1	80.7	81.4
Profits before tax	116.7	133.9	133.7	112.2	51.4	88.8
	Percent of Sales					
Total labor cost	15.4	15.3	15.5	16.0	16.2	16.6
Wages	10.7	10.6	10.8	11.2	11.4	11.5
Fresh fruit & vegetable costs	23.6	23.9	23.4	24.0	22.1	21.4
Other food ingredient costs			4.9			
Container costs	19.2	19.1	18.1	19.4	19.6	19.7
Profits before tax	3.9	4.2	3.9	3.1	1.4	2.4

Source: National Canners Association, developed by Townsend-Greenspan and Company, Economic Consultants, One New York Plaza, New York, N.Y., Oct. 1971.

Sales - 1958-1969 from Census of Manufacturers. 1970 estimated on basis of detailed price and volume data on packs of individual fruits and vegetables.

continued--

Table III-10 (continued)

Labor Cost - Payroll, 1958-1969 from Census of Manufactures. 1970 estimate from Bureau of Labor Statistics data. Fringe benefits, levels for 1957, 1967 and 1968, from 1958 Census of Manufactures and Annual Survey of Manufactures 1968. Other years estimated from data for SIC 20 in National Income Accounts.

Cost of Materials - Costs of fruits, vegetables and containers, Census of Manufactures for 1958, 1963 and 1967. Other years interpolated on basis of data in Tables 2 - 6. Other food ingredients, Census of Manufactures. Other materials, supplies, Census of Manufactures.

Depreciation - Based on data for SIC 203 from Internal Revenue Service, Corporation Source Books of Statistics of Income.

Profits - Profit margins derived from Touche Ross data for (1) a sample of California canners 1960-1968, and Northwest, East and Midwest canners for 1960-1964, and (2) a smaller sample of total company pretax margins for 1960-1970. Regional data were reweighted according to national totals from the Census of Manufactures and margin trends calculated according to profit margin proxies (ratio of value added less payroll to total sales). Estimates for 1958 and 1959 were obtained by linking to data for SIC 203 from IRS Source Books.

All Other Costs - Derived as residual.

When net income as a percent of equity in the fruit and vegetable canning industry is compared with other types of companies, they compared favorably. For the 65-67 period (Table III-11) net income as a percent of equity amounted to 9.9 percent compared with 9.2 for all canned and frozen foods, 10.1 for total manufacturing and 8.1 for all corporations. During the 1968-70 period, however, net income dropped sharply to 4.6 percent. Information for other industry groups was not available for comparative purposes. No information is available as to net income by type or size of firm.

Capital requirements for the fruit and vegetable industry are obtained primarily from standard commercial sources outside the industry. A firm must compete in the capital markets along with all other firms seeking capital. The primary requirement then is a demonstrated record of good performance and the individual firm's ability to project adequate net returns following an expanded investment program. Consequently, capital availability is expected to be directly related to profitability--and the smaller, inefficient firms will have difficulty raising the required capital to stay in business.

Time did not allow the preparation of detailed financial statements for the representative segments of the industry. As a substitute the economic cash flows used in the impact analysis are given in Tables III-12, 13, 14). (Note: General and administrative overhead has not been included in the cash flows.)

Table III-11. Net Income as a Per Cent of Equity

	(1)	(2)	(3)	(4)	(5)
	All Corporations	Total Manufacturing	Food & Kindred Products	Canned & Frozen Foods	Canning Industry Selected Group (1)
Annual averages:					
1959-61	5.9	6.8	7.3	8.0	n.a.
1962-64	6.4	7.9	7.9	6.4	8.1a
1965-67	8.1	10.1	9.2	9.2	9.9
1968-70	n.a.	n.a.	n.a.	n.a.	4.6

(1) Total company, including other seasonal and nonseasonal food products and certain foreign and other operations.

a - Average of 1963 and 1964

n.a. - Not available.

Source: National Cannery Association as developed by Townsend-Greenspan and Company.

Cols. 1 through 4 - Internal Revenue Service, "Corporation Income Tax Returns."

Col. 5 - Touche Ross & Co. study of nine major fruit and vegetable canners.

Table III-12. Economic Cash Flow for a Small Corn and Peas
Canning Plant Operating at 75 Percent of Capacity

Year No.	Year	General Facilities	Working Capital	Revenue	Operating Cost	Net Flow
1	1971	\$638	\$89	\$353	\$267	\$-641
2	1972			353	267	96
3	1973			353	267	96
4	1974			353	267	96
5	1975	149		353	267	-53
6	1976			353	267	96
7	1977			353	267	96
8	1978			353	267	96
9	1979			353	267	96
10	1980	149		353	267	-53
11	1981			353	267	96
12	1982			353	267	96
13	1983			353	267	96
14	1984			353	267	96
15	1985	149		353	267	-53
16	1986			353	267	96
17	1987			353	267	96
18	1988			353	267	96
19	1989			353	267	96
20	1990		-89	353	267	185

Table III-13. Economic Cash Flow for a Medium Corn and Peas
Canning Plant Operating at 75 Percent of Capacity

Year No.	Year	General Facilities	Working Capital	Revenue	Operating Cost	Net Flow
1	1971	\$1620	\$372	\$1484	\$1118	\$-1626
2	1972			1484	1118	366
3	1973			1484	1118	366
4	1974			1484	1118	366
5	1975	378		1484	1118	-12
6	1976			1484	1118	366
7	1977			1484	1118	366
8	1978			1484	1118	366
9	1979			1484	1118	366
10	1980	378		1484	1118	-12
11	1981			1484	1118	366
12	1982			1484	1118	366
13	1983			1484	1118	366
14	1984			1484	1118	366
15	1985	378		1484	1118	-12
16	1986			1484	1118	366
17	1987			1484	1118	366
18	1988			1484	1118	366
19	1989			1484	1118	366
20	1990		-372	1484	1118	739

Table III- 14. Economic Cash Flow for a Large Corn and Peas
Canning Plant Operating at 75 Percent of Capacity

Year No.	Year	General Facilities	Working Capital	Revenue	Operating	Net Flow
1	1971	\$4110	\$1809	\$7730	\$5433	\$-3622
2	1972			7730	5430	2300
3	1973			7730	5430	2300
4	1974			7730	5430	2300
5	1975	972		7730	5430	1328
6	1976			7730	5430	2300
7	1977			7730	5430	2300
8	1978			7730	5430	2300
9	1979			7730	5430	2300
10	1980	972		7730	5430	1328
11	1981			7730	5430	2300
12	1982			7730	5430	2300
13	1983			7730	5430	2300
14	1984			7730	5430	2300
15	1985	972		7730	5430	1328
16	1986			7730	5430	2300
17	1987			7730	5430	2300
18	1988			7730	5430	2300
19	1989			7730	5430	2300
20	1990		\$-1809	7730	5430	4109

SELECTED BIBLIOGRAPHY

1. American Frozen Food Institute, Frozen Food Pack Statistics, 1970
2. Brandow, G. E., Interrelations Among Demands for Farm Products and Implications for Control of Market Supply, Pennsylvania Agr. Exp. Sta. Bul. 680, 1961
3. Bird, Kermit E., Frozen Convenience Foods, Past, Present, Future, Canner Packer, May, 1971
4. Canner Packer, The Magazine of Convenience Food Processing, selected issues
5. Canning Trade, selected issues
6. Dennis, C. C. and L. L. Sammet, Regional Location of Production and Distribution of Frozen Strawberries, California Agr. Exp. Sta., Mimeo. Report 231, 1960
7. Coastal Plains Regional Commission, The Economic Alternatives of Producing and Marketing Fruits and Vegetables in the Coastal Plains Region of Georgia and the Carolinas, 1971
8. George, P. S. and G. A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980, California Agr. Exp. Sta. Giannini Foundation Monograph No. 26, 1971
9. Hutchings, H. M. and G. B. Davis, An Economic Analysis of Inter-regional Competition in the Frozen Pea Industry, Oregon Agr. Exp. Sta. Tech. Bul. 72, 1963
10. Judge, Edward E. & Son, The Almanac of the Canning, Freezing and Preserving Industries, 1971
11. Judge, Edward E. & Son, The Directory of the Canning, Freezing and Preserving Industries, 1970-71
12. Mississippi Agr. Exp. Sta. and Coop. Ext. Sv., Technical Recommendations and Economic Evaluations, Fruits and Vegetables, 1970
13. National Cannery Association, Canned Food Pack Statistics, 1970-71

SELECTED BIBLIOGRAPHY (continued)

14. National Canners Association, Townsend-Greenspan and Company, Inc., Position of National Canners Association with reference to Phase II of the Wage Price Control Act of 1971
15. National Commission on Food Marketing, Organization and Competition in the Fruit and Vegetable Industry, Technical Study No. 4, 1966
16. Pearson, James L., Utilization of the South's Vegetable Processing Capacity, Fla. Agr. Exp. Sta. and Economic Research Service, U. S. Department of Agriculture, Agr. Econ. Research Report EC 68-5, 1968
17. Pearson, James L., The Economic Feasibility of Processing Selected Vegetables in Northeastern North Carolina, Economic Research Service, U. S. Dept. Agr. and Fla. Agr. Exp. Sta., Report No. ERS 279, 1966
18. Pearson, James L. and Thomas G. Brown, The Economic Feasibility of Commercial Fruit and Vegetable Production and Processing in the Missouri Delta, Missouri Agr. Exp. Sta. Special Report 69, 1966
19. Polopolus, Leo and Clayton Strebeck, Feasibility of Additional Vegetable Processing Plants in South Central Louisiana, Louisiana Agr. Exp. Sta. DAE Research Report No. 341 for Area Redevelopment Adm., U. S. Dept. Commerce, 1965
20. Porter, Charles W., The Vegetable Industry -- A Review of Progress and Prospects, The Vegetable Situation -- a Reprint, Econ. Res. Sv., U. S. Dept. Agr., 1970
21. Reed, Robert H., Economic Efficiency in Assembly and Processing Lima Beans for Freezing, Calif. Agr. Exp. Sta., Mimeographed Report No. 219, 1959
22. Smith, Wade T. and Leigh H. Hammond, Feasibility of Producing and Processing Selected Vegetables, Southern Coastal Plains, S. Carolina, Agri Division, Dunlap and Associates, Inc., Report 118, 1968
23. Southern Cooperative Series, Planning Data for Marketing Selected Fruits and Vegetables in the South, Part I - Canning Handbook, Part II - Freezing Handbook, Bulletins No. 148 and 150, 1969
24. Sunkist Growers, Inc., 1971 Supplement, Statistical Information on the Citrus Fruit Industry, 1971

25. U. S. Department of Agriculture, Heinstra, Stephen J., Food Consumption, Prices, Expenditures, Economic Research Service, U. S. Dept. Agr., Agr. Econ. Report No. 138, 1968
26. U. S. Department of Agriculture, Economic Research Service, The Fruit Situation, various issues
27. U. S. Department of Agriculture, Economic Research Service, The Vegetable Situation, various issues
28. U. S. Department of Agriculture, Economic Research Service, Conversion Factors and Weights and Measures for Agricultural Commodities and their Products, Statistical Bulletin No. 362, 1965
29. U. S. Department of Agriculture, Foreign Agriculture Service, U. S. Foreign Agricultural Trade, Statistical Report, various annual summaries
30. U. S. Department of Commerce, Bureau of the Census, Census of Manufactures, 1958, 1963, 1967
31. U. S. Department of Interior, Federal Water Pollution Control Adm., The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, 1967
32. Unger, Samuel G., Termination Report, Fruit and Vegetable Processing Capacity in the North Central Region, Agri Division, Dunlap and Associates, Inc., Report No. 122, 1968
33. Wissman, D. J. and Gary M. Mennem, Demand for Mexican Fresh Fruits and Vegetables in Central United States, Agri Division, Dunlap and Associates, Inc., Report No. 491, 1971
34. Bogue, Donald J. and Calvin L. Beale, Economic Areas of the United States, The Free Press of Glencoe, Inc., April 1961.
35. National Cannery Association, Solid Water Management in the Food Processing Industry, prepublication. Completed under contract with the Environmental Protection Agency, 1971.

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